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THE EXPLORATION OF TIBESTI, ERDI, BORKOU, AND ENNEDI IN 1912–1917: A Mission entrusted to the Author by the French Institute

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Read at the Meeting of the Society, 19 January 1920. Map following p. 160.

[*Note: The names in the text are spelled in accordance with the manuscript of Colonel Tilho, a few of the principal names—as Chad—in their English form, but the greater number in the French transliteration of Arabic. On the accompanying map the names are transliterated according to the G.S.G.S. rules for transposing from the French to the British system. The retention of the French spelling in the text has the double advantage of familiarizing the student with the two systems, and of preserving in some degree the character of the lecture, which was delivered in French.*—ED. *G.J.*]

1. Object of the Mission.

BEFORE I begin my lecture, allow me to express once more, in your presence, my heartfelt gratitude to the Council of the Royal Geographical Society for the high recompense accorded me on the occasion of my last journey in Central Africa.

It is of this journey, its chief incidents, and most important results, that I am about to have the honour of giving some account. Let me first of all explain to you, in a few words, what, from a geographical point of view, was the object of my expedition.

Explorations in Central Africa, made during the second half of the nineteenth century and in the beginning of the twentieth, had left unsolved a very interesting problem: it had been noticed that the level of vast stretches of desert, several hundred miles north-east of Lake Chad, were considerably lower than that of the lake—the difference amounting in some places to 260 feet; besides this, a wide continuous trench, offering the appearance of an old valley—the Bahr El Ghazal—led from the lake to this low-lying ground, and seemed to stretch far away to the north-east, between the mountain groups of Tibesti and Ennedi. On proceeding towards the north-east, an increasing analogy is to be noticed between

the málacological fauna of the Chad basin and that of the Nile. Besides which there had been found recently, in the waters of the Chad, a shrimp till then only found in the Nile basin—the *Palæmon Niloticus*, Roux. In short, all these signs appeared to confirm the supposition that the basin of the Chad was not a closed basin, but belonged to that of the Nile, and was a former affluent of the old river on whose banks had sprung up and flourished one of the most brilliant and ancient civilizations of the world.

This was the hypothesis that the French Institute wished to have investigated, and in the early part of 1912 I had the honour to be chosen to undertake the necessary researches. May I tell you how the mission thus entrusted to me fulfilled my dearest wish? From my early youth I had felt myself irresistibly drawn towards Africa, and I was filled with a desire to take a modest share in the discoveries of great explorers, whose intrepid expeditions had revealed to the civilized world some part of the mysterious and immense dark continent.

You doubtless remember how vague, some thirty years ago, was our knowledge of that part of the world. At that time—which now seems so far away even for those then living—I had for chaplain at the grammar-school a holy man who was an ardent patriot; in his Sunday sermons he used to talk to us a little of our duty to God, and still more of our duty to our humiliated country, which was waiting and meditating, as it laboured, on the possible reparation of the iniquities of 1871. His voice, sad at first while he spoke of our disasters and the sufferings of our lost provinces, soon grew eager and thrilled as he showed us the new way to be taken by children, as we then were, to raise the prestige of our flag: he would speak to us of that mysterious Africa, half revealed by Livingstone, Stanley, and Savorgnan de Brazza; and I fancy, after these thirty years, I still hear the sound of the name of Savorgnan de Brazza re-echoing through our humble chapel and thrilling like a bugle-call. Then, of an evening in the class-room, I would ponder over the map of Africa, where amid great blank spaces appeared in the centre of the continent a few geographical features, one of which, coloured in blue, Lake Chad, possessed a singular fascination for me.

Some years later, on leaving Saint-Cyr, I began to look forward to the realizing of my dream: after a first campaign in Madagascar, I was sent out to serve on the banks of the Niger in 1899; and since that date each successive campaign in Africa allowed me to push a little further eastwards, and so get to work on a fresh item of the programme I had set myself to carry out: to establish an accurate geographical liaison between the basins of the Niger, the Chad, and the Nile, and unite by a great transversal line the extreme ends of the routes followed by Nachtigal to Tibesti, Borkou, Wadai and Dar Four.

In 1912 I was ordered to take command of the province of Kanem for the purpose of preparing a projected expedition against Borkou,

where the Senoussists had established their chief centre of agitation and anti-French propaganda, and whence they periodically sent out plundering expeditions, which spread ruin and desolation among the peaceful tribes placed under our protection. About the same time, the Académie des Inscriptions et Belles-Lettres entrusted me with the mission I mentioned above, concerning the supposed connection between the basins of the Chad and of the Nile. Of this latter expedition, which lasted five years —1912–1917—I now propose to give you a *résumé*.

2. From Congo to Borkou.

From Congo to Lake Chad.—I do not think there would be any real interest in a detailed account of my journey to Kanem; I followed a route pretty well known, the Congo–Ubangi–Shari route. We left the steamer at Matadi, at the foot of the cataracts, and took the Belgian railway which leads to Kinshassa on Stanley Pool, at the head of the cataracts; from there, after crossing the Congo to land at Brazzaville, we proceeded on a river-steamer, first up the Congo itself, and then up its tributary the Ubangi, as far as Bangui. Farther up, lighter steamers enabled us to surmount the rapids and reach Fort De Possel, a little post built on the right bank at the point where the Ubangi changes its course. From Fort De Possel we went by land to Fort Crampel, covering nearly 160 miles of the zone which divides the waters between the basins of the Congo and the Chad. A fine road for motor-cars was being completed when I passed, but the only means of transport was carriers on foot. At Fort Crampel we embarked in small boats and descended the Gribingui till it falls into the Bahr-Sara, taking farther down the name of Shari; from thence we proceeded on a river-steamer up the Shari till we reached the Chad, and crossed over to the post of Bol, on the northern shore of the lake; and finally, in four more stages, we reached by land the town of Mao, the military and political centre of Kanem.

This journey, which takes about twelve or fourteen weeks, according to the season, is very interesting for travellers, and especially for sportsmen, who find opportunity for exercising their skill on game of all sizes, from the elephant and the lion to the modest guinea-fowl. I may mention that when I passed by the banks of the Shari, the remembrance of the exciting hunts of the celebrated aviator Latham, killed by a buffalo, was still fresh in every one's mind; but does any one remember Latham now? We should notice that this line is still far from comfortable, and that the ever-present danger of catching the sleeping sickness through the myriads of glossina-flies that may sting the traveller, spoils all the pleasure one would feel in beholding the splendid landscapes of tropical rivers flowing beneath the shady arches of the quiet forests.

A Year in Kanem (1912–1913).—I will pass briefly over the twelve months' period of my command in Kanem and the neighbouring districts. My daily task—military, political, administrative, and judicial as well—

was such that the days seemed too short for the business to be done. It must be said indeed that the Kanembus, the Budumas, the Toubous, and the Arabs of this region may be reckoned among the most quarrelsome and litigious people one can imagine.

But the great matter was to be informed in time of the Senoussist raids, and when that could not be done, to discover and cut off their retreat towards their distant haunts; but we had to do with old stagers of the Sahara, who knew admirably well to wait for the right moment, and beat a rapid retreat with their booty once the thing was done.

Another important matter was the material preparation for the expedition planned against Borkou and Tibesti, where the Senoussists assembled their bands of brigands, and where they concealed their booty: camels, horses, cattle, and, above all, women and children, carried off into slavery.

The secrecy of this expedition was ensured through the simple fact that our enemies' spies had so often announced the formation and imminent setting out of a punitive column, as to render the Borkou gentlemen quite incredulous of its possibility; they were startled, however, when in July I led a reconnoitring party to the extreme limits of our frontier, but as I retraced my steps without going beyond this line, they were confirmed in their opinion that we should not dare to attack their fortress of Ain Galakka, and they recommenced more boldly than ever their incursions and plunderings among our villages and our tribes. For this reason, when, in the early November of 1912, Colonel Largeau came and assumed the command of an expeditionary column, our departure for the north-east was not considered by the Senoussists of Borkou as more threatening to them than any reconnoitring party of the preceding months had proved to be.

3. In Borkou.

The Conquest of Borkou.—Our expedition consisted of 400 black soldiers, with two mountain-guns; about 200 Arab and Toubou volunteers, forming a "goum" or party of scouts, accompanied the column. We carried with us provisions for forty days, and the total number of our camels was about 2000. By a rather extraordinary piece of good luck, our forward march was not disturbed by the enemy. The season was favourable, the days not being over-hot, and the nights fairly cool; the usual temperature at sunrise was about 60° Fahr., but a very strong wind, blowing from the north-east and raising blinding clouds of sand, made it seem a great deal colder. Our march was skilfully concealed as far as Kourouadi, a point from which we could threaten the fortress of Ain Galakka as easily as that of Faya. There, after allowing the troops a day for rest and final preparation, it was decided to strike a decisive blow at Ain Galakka, the principal centre of the Senoussist forces.

Our column, leaving its convoy a dozen kilometres in the rear, under a guard of fifty men, appeared before Ain Galakka on the morning of

THE COLUMN HALTED AT THE WELLS OF KOUROUADI, BORKOU

THE FORT OF BERRIER-FONTAINE, OASIS OF FAYA

ROCKY COUNTRY BETWEEN THE OASES OF YARDA AND BÉDO, BORKOU

DANCE OF THE NAKAZZAS, OASIS OF FAYA, BORKOU

27 November 1913; the enemy were completely surprised. The attack began by a bombardment of no more than about a hundred shells, which did great damage inside the *zawia*, and made in the outer wall many a breach for the infantry to pass through. The assault was opened at ten o'clock; the defenders, though not numerous, offered a vigorous resistance, preferring to die rather than surrender; by mid-day the entire fortress was in our hands. We had about forty casualties, of which a third were killed.

Leaving our wounded in Ain Galakka with a small garrison, we marched on the *zawia* of Faya, which we entered without striking a blow on December 1. Thence proceeding still farther into the desert, we reached in a week's time Gouro, a point 200 kilometres north, the religious and political centre of the Senoussists in Central Africa, which was seized after a short struggle. Then, continuing its successful march towards the east, the column took possession unopposed of the oasis of Ounianga, 60 miles from Gouro, and leaving a small garrison there we returned to Faya, the best place to be chosen for the military and political centre of the newly conquered territory.

Importance of the Conquest of Borkou.—This laborious campaign had the very important result of depriving the Senoussists of the valuable *tête de pont* on the south side of the Sahara which Borkou constituted for them, enabling them to distribute over Central Africa arms, ammunition, and propagandists of the holy war.

The great value of our conquest appeared plainly a few months later, when the German Emperor let loose on the world the most awful war that ever convulsed the Universe: a Germano-Turkish mission, headed by Nuri Bey, a brother of Enver Pasha, the Turkish Minister of War, landed in Cyrenaica for the purpose of organizing, with the help of the Senoussists, an outbreak in Central Africa against the protectorates of France and Great Britain. This would have been an easy matter if our enemies had been able to establish their headquarters in Borkou, for they would then have been only a few hundred miles from German Bornou on one side, and on another from Dar Four and Dar Sula, which showed a certain hostility towards us. There is no doubt that, in this case, the Anglo-French campaign in the Cameroons would have been conducted in very different circumstances; when we take into consideration the large stock of arms and ammunition prepared by the Germans in their colony, and the care they had taken to fortify the mountain of Mora, we may suppose that the German staff had hoped to establish by main force a continental junction between the Cameroons and Turkey, through Kanem, Borkou, and Libya, in case of the communication by sea being cut off. And I do not think I shall betray any State secret by informing you that the Chad territory, with its modest resources in men and ammunition, would have been very difficult to defend with any chance of success against such an attack. I may also add that, had the Turco-Germans been able to

accomplish their design, the result would have been exceedingly perilous for Franco-British rule throughout the whole of Dark Africa.

By uniting, under my command, our frontier territories of the Libyan desert, the French Government's aim was to constitute a force able to resist any attempts that might be made to retake from us the excellent base of operations that Borkou afforded.

Four Years in Borkou (1913–1917).—I do not think it would be of any great interest to lengthen this geographical lecture by explaining to you the difficulties of every kind that I was obliged to overcome during about four consecutive years, in order to fulfil the military task allotted to me. As Borkou produces little else but dates, and Ennedi scarcely anything at all, I was compelled to procure from Kanem and from Wadaï the corn, meat, and other food-stuffs necessary for the maintenance of my civil and military subordinates. Now, the organizing of the commissariat transport became more and more difficult every six months; the want of pasture along the roads we had to take, the incessant raids of the nomads and the counter-raids of my troops, caused irreparable losses among our camels. From the end of 1913 to the first months of 1917, the activity of the rebels was so great, owing to the instigation of the Turco-Senoussists, that my troops could get no rest.

A Bird's-eye View of the Country.—When on leaving the shores of Lake Chad we proceeded towards the north-east, we first entered into a sandy region, with parallel valleys running between grassy downs that rose to a height of not more than 300 feet: this was Kanem, the country of corn and cattle, where subterranean water abounds and where it is easy to live.

After marching for about 100 miles, we left this fertile country and dropped quite suddenly into the desert itself, with its dull, empty, vague horizons, so monotonous that the slightest details interested us, such as a line of stones on the sand, the sight of a crescent of sand-dunes, or a poor, solitary, half-dead shrub; also our passing through a meagre pasturage of dusty *had* was quite an event, or the discovery in the distance of a few green bushes of *siwak*, till we reached the wells, where we were to rest all day long, to lead the camels to drink, and renew our own provision of water, which was often brackish and evil-smelling. This was the deceptive desert of the Lowlands of the Chad, the region I mentioned above as being lower in level than Lake Chad itself.

After a further march of about 250 miles we entered the country of rocks; at first scarcely visible above the sands, they soon rose in sharp peaks that looked like mediæval ruins, and then shot up into long steep cliffs bordering rugged plateaux, that formed ledges one above the other to the foot of the mountains: this was the region of Borkou, Tibesti, and Ennedi, the very heart of the desert, situated at almost the same distance from the shores of Lake Chad, the Nile, and the Mediterranean. This rocky belt forms, from the Tripolitain to Dar Four, a long broken wall,

encircling on the north-east the basin of the Chad, which it divides from the dismal and unexplored waste of the Lybian Desert. Tibesti and Ennedi form the highest and almost inaccessible parts of this region, while another part, Borkou, consists of a wide depression between the basins of the Chad and of the Nile.

4. The Oasis of Borkou.

Faya.—The *zawia* of Faya had been chosen as the military and administrative centre of French Borkou, in preference to those of the Senoussists (Ain Galakka and Gouro), because it offers the least unfavourable lines of communication with the garrisons of Gouro, Fada, and Ounianga, and the best position for joining Borkou by wireless telegraphy to the nearest post of the Chad territory, 350 miles to the south.

The huts of the Senoussist *zawia* sheltered us from the sun and the sand-storms, but they were in such a state of ruin and decay that we were obliged to begin at once and make bricks—unbaked, of course. Unluckily, for constructing our buildings we were obliged to depend o the work of the few black soldiers who were not employed in exterior operations; so that many months elapsed before we could build a sufficient number of habitable houses, and complete the detached works of our defensive arrangements, including three rows of rope network, supposed to be barbed, by means of the addition of long thorns from the date-trees.

The landscape from the summit of the square donjon which overtopped the fort, though wanting in charm and beauty, was not without a style of its own; the post was built in the middle of a broad valley, closed in on the east, but opening spaciously towards the west; its rugged, steep, rocky sides plunging into shifting sands and wind-swept dunes, each dune curved into the form of a crescent.

At the foot of the fort the axis of the valley was delineated by fine rows of date-bearing palms, about 500 yards wide by 20,000 long, broken at intervals by heaps of moving dunes. On either side of the palm-grove there stretched green meadows, which looked as though they would afford fine pasturage for cattle, but which in reality were covered with sharp, hard grasses and herbs of no nutritive value: the most characteristic and the least bad was *akul*, a regular little bush of sharp thorns, which the camels would eat, but not without making a funny grimace at every mouthful.

All along the valley there lies a sheet of subterranean water, which rises in some places so near to the surface that the gazelles and jackals easily slake their thirst by scraping away with their feet a few inches of the soil; here and there, indeed, a little stream of water flows out of the sand, and runs a few yards towards a neighbouring depression, and little pools are formed in natural or artificial hollows made in the soil.

These jackals and gazelles are the only wild animals found in Borkou; the latter are quite unapproachable by hunters, while the former remain

hidden in the daytime, but come in bands at night, yelping round the villages, and penetrate boldly into inhabited enclosures to seek their prey. So cunning are they that they avoid the most ingenious traps the natives can set. The lion, the panther, the hyena, and the wild boar never pass beyond the desert boundaries of Kanem and Wadaï; even the antelope and the ostrich, though bearing thirst so well, cannot venture so far into the Sahara.

The winged domestic tribe is seen among the villages in the shape of rare squads of lean fowls; and flights of turtledoves and pigeons roost in the palm trees. A graceful species of sparrow, with black plumage and white tails, fly in and out of the rocks, and even come into our clay-houses; they sing like nightingales when building their nests, and chirp like sparrows while they watch their young beginning to fly. All round the inhabited houses the black crows may be heard croaking: they are extremely audacious, whether attempting to snatch pieces of meat roasting before a kitchen fire, or settling on the back of a wounded camel and tearing off with their beaks morsels of bleeding flesh.

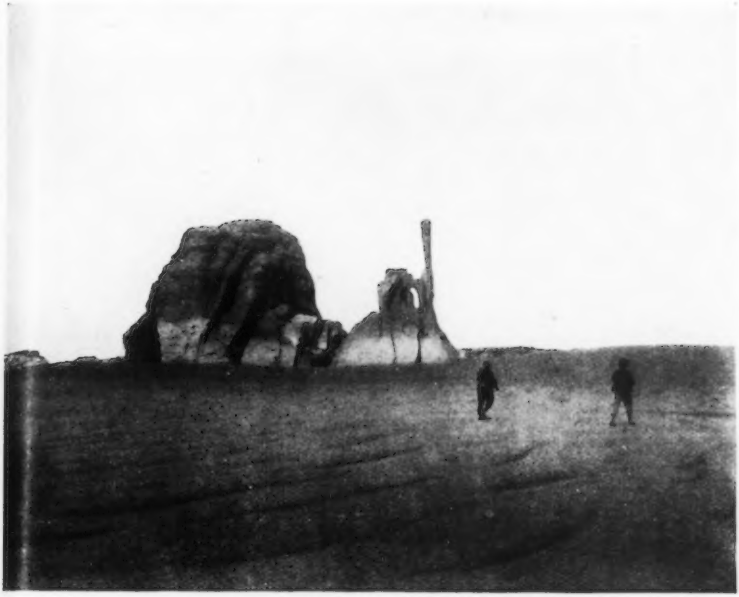
Snakes are fairly common, the largest being hardly more than a yard in length and one or two inches thick; the most dangerous is the short bulky viper that lies hidden in clumps of grass, and whose bite is fatal even to camels. Scorpions abound, generally of a greenish hue, sometimes black; their sting is very painful, and may be eventually mortal to women and children.

Amidst the rocks one may find a curious eatable lizard, the "dundou"; it is inoffensive, but when it does bite, it bites so fiercely that the only way of making it let go is to pinch its tail sharply, either with pincers or with one's teeth.

There are very few domestic animals save the ass and the goat; but small herds of oxen manage to cross the desert from November to February, when cool days, pools remaining from the rainy season, and the scanty pasturages of grasses produced here and there by the few summer showers allow them to pursue their march by short stages.

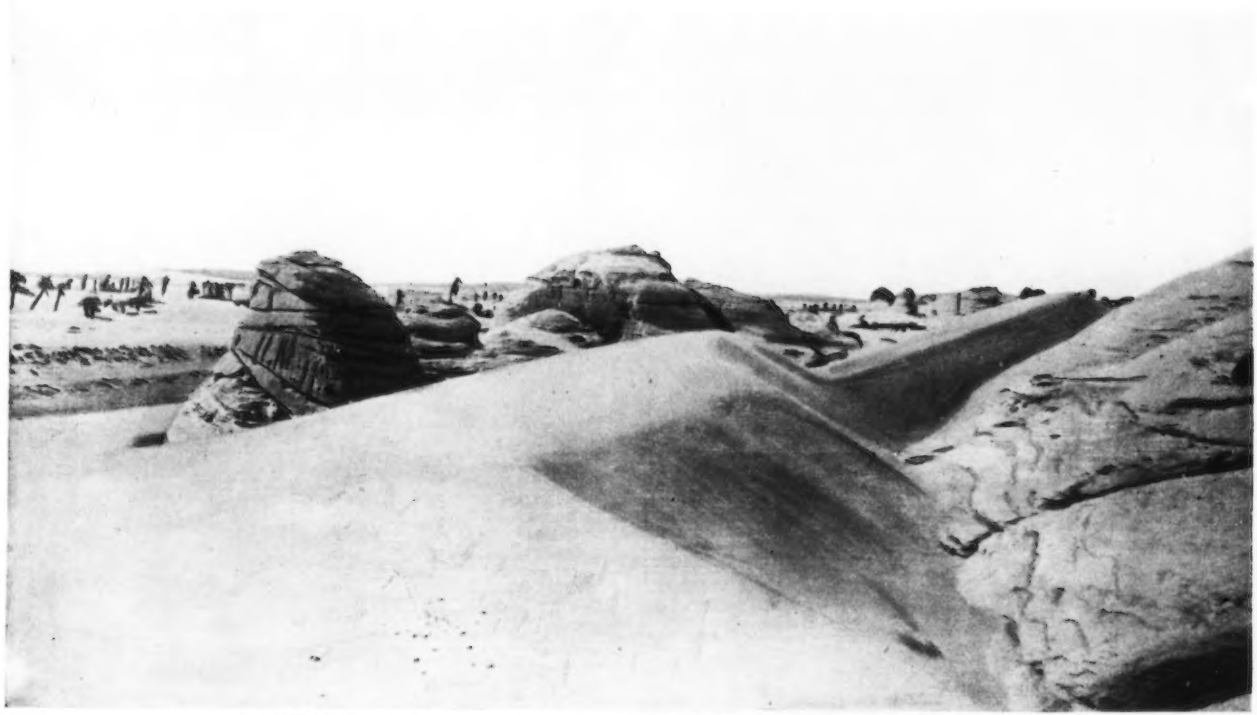
Where the animal kingdom exhibits its greatest vitality, however, is in the insect world: the common fly, dirty and worrying, rules despotically by day, together with gad-flies and big stinging flies of a pretty greenish hue. At nightfall, the very time when one might enjoy a little rest on the terrace of the houses, moths, coleopters, locusts, dragonflies, and bugs become very lively, and whirl madly round the table where a light is shining, so that it is far preferable to dine lighted only by the moon and the stars. When there is no wind at night there are swarms of mosquitoes, and also of a kind of little sand-fly that pass between the meshes of the best mosquito-nets.

Cultivation.—The soil indeed is not very fertile, which is the reverse of the account given of most oases in the north of the Sahara. It is especially favourable to the cultivation of the date-bearing palm, which



SANDSTONE ROCKS NEAR ORORI, BORKOU

ROCK DRAWINGS, OASIS OF YARDA, BORKOU



SANDSTONE ROCKS ATTACKED BY MOVING DUNES, OASIS OF YARDA, BORKOU

loves to have its foot in the water and its summit in the burning sun, but does not stand rain well. The first dates ripen in the month of May, while the latest are gathered in September; they vary in size, and are dark or light in colour according to their variety, but nearly all are of a very good quality, as sweet and fleshy as one could wish. The greater part of the crop is put to dry, while the most luscious are gathered into heaps and pressed into goatskins, to be carried to Wadai and Kanem and other places farther off.

After the date-gathering the natives prepare their gardens for the sowing of corn, which takes place in November and December. The ground is arranged in small squares, ingeniously adapted for irrigation; but the produce is meagre owing to the want of manure; this is remedied, to a certain extent, by an addition of virgin soil, containing more or less soda, which is fetched from some distance on donkey-back. The gardens are intersected with long parallel hedges, which shelter the ears from the withering violence of the north-east wind. The harvest is gathered in towards the end of March, and a short time later the ground is prepared for the sowing of millet, which yields a still smaller crop than the corn. When we add that in some gardens there grow a few onions and tomatoes, as well as a kind of spinach, scarcely appreciated anywhere but in Borkou, we shall have enumerated nearly all the available food-stuffs of the oases.

I must not forget to mention that the Senoussists had succeeded in importing to Gouro and Faya some fig-trees and a few vines; and on our side we managed to acclimatize the sweet potato, a precious resource which came from Kanem. We were less fortunate in our repeated attempts to acclimatize French vegetables, which succeed so well in the neighbourhood of Lake Chad during the cool season; the poverty of the soil, the want of manure, the extreme dryness of the north-east wind, the voracity of the grasshoppers and other destructive insects, were no doubt the causes of our lamentable failure as agriculturists.

Winds and Rain.—In the heart of the Sahara, where rain is so rare a meteorological phenomenon, the wind is the high arbiter of each day's weather. The weather is fine when the wind is light, and bad when it is strong; in the latter case nothing is to be seen but whirling columns of sand, raised by the north-east wind, blowing in stormy gusts and covering the whole landscape with a thick dry mist of brownish dust that penetrates everywhere and is very painful to the eyes, so that one does well on such occasions to wear motor-goggles to avoid ophthalmia. These north-east winds blow more or less violently for a great part of the year, sometimes for a few hours only each morning, sometimes for whole days and nights. I may say that we were able to note a fair correlation between the oscillations of the curves of the registering barometer and thermometer and the force and duration of these winds; they usually coincide with low temperatures and high atmospheric pressure, while the light winds or the dead calm accompany low pressure and high temperatures. Taking as a

basis the information furnished by the natives, borne out by our four years of regular observations, it may be said that, as a general rule, the north-east wind reigns supreme over Borkou and the neighbouring districts from October to May or June (that is to say, from about the autumnal equinox to the summer solstice); whereas in July, August, and September still weather prevails, alternating with gentle west-south-westerly winds.

It is these latter winds that bring with them from the Atlantic what little moisture nature measures out each year so parsimoniously to these dried-up lands. Then the sky clouds over almost every afternoon, but one's hope of refreshing showers is vain; the heat thrown up from the scorched ground, and the rapidly rising temperature through which the raindrops fall towards the earth (a rise of about 3° Fahr. per 1000 feet), are enough to bring about their more or less complete evaporation before they reach the ground, and one sees long frayed streaks of grey cloud trailing almost along the ground, like unravelled skeins of wool, from which a few rare drops fall on the thirsty earth. When we took possession of Borkou the inhabitants assured us with one voice that it had not rained in their country for eleven years, thus putting back the date of the last rain to the year 1902; by a curious chance our entry into Faya (on 1 December 1913) was greeted by a little shower of utterly unlooked-for rain. The inhabitants saw in this downfall (unusual not only for that region, but for that season of the year) a happy omen for the rainy season of 1914, an omen which was realized, for in the month of August 1914 we had the satisfaction of registering about 90 mm. of rain at Faya. In 1915 the rainfall was hardly worth mentioning, and in 1916 about 35 mm.

Though Borkou is more than 300 miles south of the Tropic of Cancer, and very low-lying (650 feet above sea-level), the heat is really excessive only for six or seven months of the year, from mid-March to mid-October. During our observations, extending over three years, the maxima registered in the hot season never exceeded 117° Fahr., but temperatures of 110° to 115° were frequent. During the cool season, from December to February, the minima sometimes fall below 50° Fahr. without ever getting down to freezing-point. The dryness of the air is very noticeable from November to June, when a difference of more than two to one may regularly be observed between the simultaneous indications of the dry and wet thermometers: for instance, when the former stands at 44° C. the second often reads less than 20°. On the other hand, in August and September, under the influence of the winds blowing from the Atlantic Ocean, the air becomes very damp and the heat grows stifling.

In spite of its excessive heat, the climate of Borkou is comparatively healthy; very relaxing during the hot and damp season, it is extremely pleasant in the months corresponding to our autumn and winter. During my stay, lasting from 1913 to 1917, none of my European fellow-workers had any serious illness, and my black troops, though kept hard at work in

the shape of arduous reconnoitring and escort duty, and with barely enough to eat, showed a percentage of sickness and deaths below the average of the other garrisons throughout the Chad Territory.

Population and Commerce.—The population of Borkou consists of nomads, the Tedas and the Nakazzas—the great nobles of the desert—and of a sedentary tribe, the Dozzas, who are only half noble, for want of the few camels whose possession would enable them to take a share in the profitable plundering raids in the desert. There is also a third category of inhabitants, the Kamajas, half serfs, half slaves, whose duty it is to attend to the gardens and the plantations of palms, and who are profoundly despised by the other two categories. The total population of Borkou would not appear to exceed some ten thousand souls, distributed among a score of more or less flourishing palm plantations.

The commercial activity of the oases of Borkou is far from negligible; they export towards the south salt, soda, and dates, and receive in exchange cereals, butter, cattle, and smoke-dried meat. Caravans of two hundred camels may often be seen coming to load up with salt at the Arouelli salt-pits near Ounianga; and Arab caravans pass by on the way from Cyrenaica, by Koufra and Sarra wells, importing to Wadai stuffs, sugar, coffee, tea, mercery, and (in time past) arms and ammunition; and exporting principally millet, butter, smoked meat, hides raw or tanned, ostrich feathers, elephants' tusks, and so forth. The slave-trade, formerly carried on through Borkou between Wadai and Cyrenaica on a great scale, has almost entirely ceased since we took possession of the country.

5. Exploration of the Western Borders of the Libyan Desert: Ounianga–Erdi

After drawing up the map of the western part of Borkou, subsequent to my reconnaissance in March and April of the various oases that succeed one another between Faya and Ain Galakka on the south and Gouro on the north, I devoted the last quarter of 1914 to an exploration of the unknown regions situated further east. Over and above their geographical interest, the said regions were of great military importance. My object was, in fact, to ascertain whether a counter-attack by the Senoussists, starting from Koufra and crossing the Libyan desert, could easily hope to escape the vigilance of our camel-corps patrols and fall on the remoter borders of Borkou and Ennedi.

From Faya to Ounianga.—With this intention I left the oasis of Faya on 1 October 1914, at the head of a small escort, taking with me only some thirty lean camels tired and mangy, only capable of short stages and of carrying light loads. The result was that I spent nine days in covering the 117 miles between Faya and Ounianga, a journey that offers no difficulties and is usually completed in five or six stages. The points at which water may be found are frequent—at least one every 20 miles—and permanent; but grazing-grounds were almost non-existent at that time in consequence of the eleven years' drought the country had just

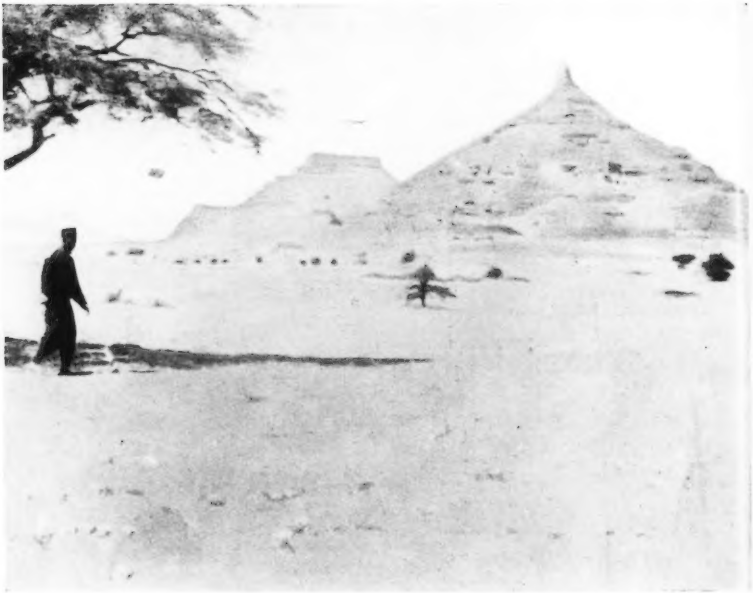
suffered from. The rain that had fallen in August had, it is true, made a few green blades spring here and there, and they were eagerly snapped up by our camels as they passed; but they were still so scattered among the broken rocks that they rather emphasized than diminished the desolate barrenness of these dreary solitudes. From place to place, round a water-hole, one found a few wretched acacias, bushes of *rtem* or tufts of *akrech*. By chance one would come across what had once been a field of dried-up *hâd* whose thorny branches were grey with dust; but in a general way the landscape was disappointingly bare, and I wondered anxiously how long my camels would hold out on this starvation diet.

The route passed alternately through hamadas of sandstone, the blackened rocks of which emerged from irregular dunes, and through sandy plains into which one sank, raising thick clouds of dust finer than ashes. We did not meet a living soul on the way, except a detachment going back to Faya, and a little caravan consisting of two delegates of the Grand Senoussi coming from Cyrenaica on their way to Fort Lamy as an embassy to the commander of the territory. I spent an afternoon with them near the wells of Eddeki, and so had the pleasure of offering them tea. The chief delegate, Si Mahmoud Sheikh, was a Khoan of fairly high rank in the Senoussist confraternity. His appearance was that of a good Mussulman "brother" by no means indifferent to the good things of this world; fifty years old, and of a fine corpulence, he had a fair but sunburnt complexion, grey hair, a black beard, a round face, thin lips, small eyes, and a sensual nose. He was dressed all in white, walked with gravity, and spoke little. His attitude, free from arrogance, was not without a touch of awkwardness, and his reserve concealed but ill his uneasiness about the fate that might await him during his long journey among the infidels.

His companion, Abdallah Ghariani, was younger and of a very modest rank among the Khoans. He had a jovial, bustling manner, and talked volubly, but his eyes were sly and shifty. While we drank tea flavoured with mint, he boasted of the pacific intentions of Ahmed Sherif, insisted on the desire of the Confraternity to maintain active commercial relations between Cyrenaica and the Wadai, and on the necessity for suppressing the Toubou brigandage that hindered the march of the caravans. In conclusion, he declared that he had eaten no meat for a long time and begged me to make him a present of a small quantity of smoke-dried meat—a precious commodity in the desert, where the resources of hunting do not exist.

Ounianga.—I reached the valley of Ounianga on October 9 in the morning, and was not a little astonished at failing to see the palm plantation till the moment of entering it; for, unlike those of Borkou, which can be seen from a distance, the oasis of Ounianga is hidden in a rocky excavation some 30 yards in depth and 4 or 5 miles long by 1 or 2 wide. The landscape thus formed is incomparably picturesque: a great

NATURAL CISTERN, ERDI



THE PEAK OF DIMI (600 m.), ERDI

THE PEAKS OF DOURDOURO (1000 m.), ERDI

sheet of calm water with blue shadows, edged with rosy-tinted beaches of sand, and fringed with green palm-trees stretched within a circle of bare wind-carved sandstone whose sombre hues cast here and there, under the blazing sun, warm shadows glowing with red or gold.

But it must be recognized that in spite of its beauty the palm plantation of Ounianga is but wretchedness, gloom, and disappointment. The inhabitants, known as Ounias, are few—some hundreds at most. On the other hand, millions of flies fiercely exercise their buzzing activity for fourteen hours a day on man and beast. The soil is unfruitful, and produces hardly anything but dates. The foodstuffs necessary to life—cereals, butter, smoke-dried meat—are brought at great cost by caravans coming from Abéché to seek the supplies of salt from Arouelli needed by the inhabitants of Wadai. Even the camels cannot live in the neighbourhood for want of enough pasture, and from this cause our little garrison had the utmost difficulty not only in getting supplies, but in fulfilling the mission of watching the approaches of the frontier, and especially the great road from Koufra that emerges from the Libyan desert in the region of Tekro Arouelli.

It occupied at the north end of the lake a little rectangular fort, solidly built, but surrounded at a short distance by rocks that blocked the view and overlooked it to the north and east. It had not been possible to find a more favourable site, offering at the same time extensive views and an easily accessible water-supply.

I devoted two days to different tasks (inspections of the garrison, interviews with the Ounia chiefs and with two Khoans, former governors of the country in the time of the Senoussist domination, and so forth), and set out again on October 11 to visit the last water-points before entering the Libyan desert.

The Libyan desert is still almost completely unknown, no European traveller having been able as yet to cross it from side to side, whether from north to south or from east to west. In 1870 Gerhardt Rohlfs visited the northern part, as far as the oases of Koufra; a quarter of a century later British officers penetrated the south-eastern region as far as Bir Natrun, about 200 miles west of the Nile. On our part, we have been able to explore the south-western district and to obtain in respect of the central part fresh information, which it will not be easy to verify and extend until the French, British, and Italian governments combine in organizing for that purpose a geographical expedition, which would be of considerable scientific and even political interest.

I first took the direction of the salt-pits of Arouelli, situated 28 miles to the northwards, where I met a caravan that had just loaded up with 30 tons of salt for the Wadai markets. The salt-bed lies at the bottom of an absolutely bare sandy depression, covering some 25 acres. The bed of salt, which is only about 6 or 8 inches thick, is on the surface, and more or less mixed with sand. The water-bearing stratum lies at a depth of 5 or 6 feet, and the water is naturally very salt. The water, rising to the

surface by capillarity, evaporates, forming the salt crust that the caravans carry away in pieces, and which the natives of the Wadai and the countries bordering on it consume without further preparation. If one may trust the information supplied by the Ounias, the salt crust forms again about three months after being taken away, so that the output of the Arouelli pits would amount to nearly 100,000 cubic metres of salt annually, an output sufficient to satisfy the culinary needs of more than ten million people, and worth on the spot, as prices were before the war, some fifteen million francs.

From Arouelli I went eastwards to fix the position of the well of Tekro, where there is also a deposit of salt which is not worked, the admixture of sand being too great. The well of Tekro is particularly important, because it is situated at the extremity of the great caravan route joining the Mediterranean to the Soudan by the oases of Koufra and the well of Sarra. The water is abundant and fairly fresh, but the vegetation is reduced to a hundred clumps of siwak and a few tufts of grass of no value for the feeding of camels.

The Route towards Koufra.—Between Tekro and Koufra the distance to be covered is about 350 miles, about half of which had just been reconnoitred by Lieutenant Fouché, commanding the garrison of Ounianga. Marching in a general direction north-north-east he had first crossed a rocky zone of slight elevation, spending four hours in doing so; then for two days he traversed an immense sandy plain, bare of all vegetation, with here and there stretches of rock surface level with the ground; broken lines of rocky heights were visible in the distance to east and west. These heights went to join the plateau of Jef-Jef, in the direction of which he marched for twelve hours during the third day. On the fourth, he found himself in a vast plain from which the Djebel Habid, 50 miles away to the east, can be seen during the first few hours. The fifth day ranges of moving sand-dunes that served as landmarks for the guides were observed to the north-west, and at last, at nightfall on the sixth day, he reached the well of Sarra, lying in a hollow running from south-west to north-east and 30 metres deep.

The site of the well was chosen by the revered Sidi el Mahdi about 1898, and the works began almost at once. The boring, all done with picks and crowbars, was effected in hard reddish sandstone, by gangs of six workmen, relieved every month, and supplied with food and water by an endless succession of camel-convoys. At the end of eighteen or twenty months of uninterrupted work the water was at length found, clear, fresh, and abundant, at a depth of 80 yards, and since then the crossing of the Libyan desert has become relatively easy, the longest stretch without water being reduced to about 180 miles, whereas it was formerly almost 300. From the well of Sarra to Koufra the distance to be covered is only about 160 miles and offers no further difficulties, thanks to the intermediate well of Bechra.

What makes the journey from Ounianga to Koufra particularly troublesome is the total absence of pasturage for 500 miles, a state of things that results in the loss of many camels on every journey. The only good pasturage in the whole region is said to be found 80 or 100 miles to the east of the Sarra well, in the Djebel El Aouinat, an unexplored mountain mass of an extent not exceeding 1500 to 2000 square miles, as I am informed, and whose altitude may be roughly put at from 4000 to 5000 feet. It goes without saying that I only give these figures as a mere indication, and as subject to caution in every respect.

The break in continuity between the surveys of Rohlfs from the Mediterranean to Koufra and ours from the Wadai to the well of Sarra is consequently reduced to about 180 miles; but this gap does not seem likely to be bridged before Italy proceeds to an effective occupation of the oasis of Koufra, which falls within her sphere of influence.

Having ascertained the site, depth, and value of the Sarra wells, Lieutenant Fouché, in accordance with his instructions, set himself to march back to Ounianga, but the return journey was particularly dramatic. For from the very first day his guide led him directly south, instead of marching south-south-west. One is justified in supposing that he meant to lead astray in the desert the detachment whose camels were so exhausted that everybody went on foot, and whose store of water was limited to a little less than a gallon a day per man. Astonished at this unaccustomed deviation, the lieutenant drew the guide's attention to it, but the latter answered: "Do not be uneasy, we are on the right road." But when he judged that the column was far enough from the tracks left by the outward journey, he replied to a fresh observation made by the lieutenant: "You are probably right, for I no longer see my usual landmarks; but if you would lend me a camel and a skin of water, I would go and find our tracks of the other day, and as soon as I had found them I would come back to look for you." The lieutenant thought it wiser to turn guide himself, and, compass in hand, he put himself at the head of the caravan, with what anxiety may be guessed! An error of direction of a few degrees—quite a usual thing in marching by the compass with no natural landmarks—might work out at a matter of 15 miles in a distance of 180, that being the distance to Tekro. And the well had to be found, in the immensity of the desert, before the detachment's scanty water-supply gave out! The black soldiers' thirst was aggravated by the crushing heat; reduced to a daily ration of a little less than 4 quarts of water, they no longer ate any solid food. The camels, grown weak, slackened their pace. The men, uneasy at not coming across their traces of the outward journey, thought themselves hopelessly lost. Their feet, swollen with weariness and made painful by the burning sands, seemed incapable of carrying them to the end of that interminable plain, torrid and unchanging, where the air vibrated as it vibrates above an overheated stove, creating all along the route deceptive mirages, ceaselessly dissolving and reappearing. After a while some

of them lost heart and wanted to stop, preferring to wait for death where they were rather than go on with an aimless march. The lieutenant tried to cheer them up by singing the praises of his compass, and promising them that on the morning of the seventh day the three familiar rocks near the well of Tekro should appear before them on the horizon. Incredulous, but respectful, they betook themselves again to their journey, advancing automatically behind the camels as exhausted as themselves, and by some miracle, on the promised day and at the promised hour, they saw faintly outlined against the far horizon the rocks of their salvation! A few hours later, bivouacked round the well of Tekro, the brave fellows who had just covered 350 miles on foot in fourteen days in conditions of the utmost hardship, had forgotten their weariness and were contemplating with respect, on the lieutenant's table, the "good little iron" that had saved them from the most horrible death.

As for the guide, he was left unmolested, his criminal intention not being susceptible of absolute proof. It was the wisest course to take, for by punishing him without proofs, all we should have gained would have been to terrify men whom we might need later on! In the desert, the best guides may have their weak moments!

From Tekro to Ounianga.—From Tekro I came back to Ounianga, and continuing eastwards by the lakes of Little Ounianga and N'Tegdey I reached the salt-pits of Dimi, after crossing a chain of little sand-dunes about 50 feet high, stretching from north-east to south-west, and extending from 5 to 6 miles in breadth. This salt-pit lies in a sort of huge circle of rock, in the middle of which rises an isolated conical peak 500 or 600 feet high. It seems to me more extensive than that of Arouelli, but the salt from it does not seem to be so much in demand, on account of the very large proportion of sand it contains. The result is that it is hardly used by any one except the natives of Ennedi, who have only three days' journey to go in order to get a supply of it. The grazing, though by no means abundant, was less scanty than in the regions I had just come through, and my skeleton-like camels could eat their fill, for the first time in a whole month.

From the top of the rocks of Dimi my Ounia guide, Sougou, pointed out to me in the east the almost horizontal lines of cliffs forming the most westerly point of the mysterious plateaux of Erdi. The word "Erdi" means in the language of the Toubous "expedition, razzia," and would appear to have been applied to that region from time immemorial because it served as a meeting-place for the bands of raiders who put the caravans to ransom and pushed their raids as far as northern Dar Four and Kordofan, and sometimes even to the valley of the Nile in its middle reaches. According to the guide, rocky tablelands were to be found there, of an altitude comparable with that of Ennedi; the rains were less rare than in Borkou, the grazing-grounds for camels abundant, and the points where water could be found were hidden away in gorges difficult of

access, little known, and hard to find the way to. For his own part, he hardly knew any except those of Erdi-Dji and Erdi-Ma, separated by a distance of 70 or 80 miles.

I hesitated some time before continuing my journey towards this region, whose very name was unknown till now; my water-barrels only gave me a reserve of some thirty gallons, and my men's skin bottles were so corroded by the salts of sodium they had transported that they were empty after twenty-four or thirty-six hours' march. My camels, thin, worn out, and more and more mangy, could not do more than 20 miles a day, and I only had at my disposal ten days' supplies for my detachment, so that any error on my guide's part might put me into a critical position.

Erdi.—In spite of everything I resolved to make the attempt, trusting in fortune to ensure its success. In two marches we succeeded in reaching the foot of the cliffs of Erdi–Dji, 750 feet high and about 2000 feet above the sea. We found there good grazing for the camels, and from that day onward we had abundant fodder at each successive stage, so that I was delivered from the dread of seeing my indispensable beasts of burden waste away from inanition. The water was no less abundant, and was found in natural cisterns hollowed out by waterfalls in the beds of dried-up torrents that came down from the plateau. Some of these cisterns contained nothing but sand; but it was enough to bore a hole 1 or 2 feet deep in the sand to obtain a sufficient store of water.

From the top of the cliffs all that could be seen was an immense plateau, slightly undulating, and rising gradually towards the north-east. Beyond the line of the horizon some dozen miles away, there rose, as our guide told me, other cliffs; but all I could do was to take note of that information without being able to verify it.

Continuing our route eastwards along the foot of the cliffs, we reached five days later the region of Erdi–Ma, decidedly higher than that of Erdi–Dji: the highest altitude I had the opportunity of measuring exceeded 3000 feet. Our bivouac was installed at the entrance of the gorges of Dourdouro, where very picturesque natural cisterns are to be found containing abundant quantities of water withdrawn by the positions of the enclosing rocks from the drying action of sun and wind. During the whole of the way thither we did not see a living soul, any more than in the neighbourhood of Dourdouro.

My guide never having gone beyond that point, it was impossible to push my investigations further. Besides, I had now only four days' supplies left, a fact which obliged me to change my direction and make for Wad Mourdi, on the northern border of Ennedi, where I was to receive fresh supplies. I had eventually to be satisfied with determining the position of this point and measuring a few heights while we were renewing our store of water before starting again after a day's rest.

This expedition, though limited to the south-western border of the massif of Erdi, revealed some interesting facts about the configuration

of the country towards the 18th degree of latitude north and the 23rd degree of longitude east of Greenwich; the altitudes increased from west to east, and it seemed likely that the massif of Erdi was connected in one direction with the mountains of Tibesti by the plateau of Jef-Jef, and in another with the still unknown massif of El Aouinat, situated approximately between the 22nd and 23rd degrees of latitude north and the 24th and 25th degrees of longitude east.

Later information gave me a few further indications about western Erdi, where two water-points were found; one Bini-Erdi, about 80 miles north-east of Dourdouro, and the other, Erdi-Fouchini, some 60 miles north of Dourdouro, at the foot of a line of tall cliffs. The deduction may be allowed, for the time being, that the central tableland of Erdi offers altitudes presumably superior to 4000 feet, and that it slopes gently down on the east to the great sandy plain, without vegetation or water, across which passes the route from El Aouinat to Merga, a route that establishes direct but very difficult communication between Koufra and Dar Four, to the east of the 24th degree of longitude.

Between Erdi and Ennedi.—In leaving Dourdouro to march southwards I was going into the unknown. I could, no doubt, see in front of me, 40 miles away, the crests of northern Ennedi, at the foot of which I was to find the water-points of Aga and Diona; but to seek the said points without guide in the chaos of rocks was a risky undertaking, and might have been held unreasonable if the way our supplies were running short had not obliged me to go forward.

A vast depression, stretching from south-south-west to north-north-east and of an average breadth of some 30 miles, separated Erdi from Ennedi; it was the depression I heard spoken of earlier as a prolongation of that of the Bahr El Ghazal, through which Lake Chad once poured its waters into the lakes of Toro and Djourab, and consequently that by which the basins of the Chad and the Nile might in ancient times have entered into communication. That being so, I took the utmost care in examining the region and determining the altitudes. The lowest point was found about 30 kilometres from Dourdouro. Its altitude was 1750 feet, or 1000 feet higher than that of Bokalia at the north-eastern extremity of the Djourab. The slope was therefore from north-east to south-west, as was confirmed by the shape of the ground and the general direction of the valleys running into that depression, and I was able to conclude that if an ancient river once flowed in the bottom of that broad valley, which is hardly likely, it ran, not towards the Nile, but towards the lowlands of the Chad. By this evidence, one of the most important items of my geographical programme was fully elucidated: the basin of Lake Chad constitutes in the centre of Africa a closed basin which has never been connected with the basin of the Nile. The lake zone, now dried up, consisting of Kanem, the lowlands of Lake Chad, and Borkou, was once the outlet for the affluents of Lake Chad and for many great rivers coming

down from the mountain mass of Ennedi, Erdi, and Tibesti. Its outline at successive periods—an outline in all probability very irregular—might be indicated by the hypsometric curves 270—260—250 metres, adopting for the Lake Chad of to-day the altitude of 240 metres. Its extent at that period must have been comparable with that of the Caspian Sea at the present day, and its greatest depth some hundred metres.

In the evening of the second day's march, when we were drawing near the foothills of Ennedi, we had not yet found any well, and our tiny store of water was used up. But spying in the west a notable gap in the line of hills, I thought we should be likely to find a water-point there, and profited by the coolness of the night to try to reach it. At dawn we came out on a fine river, dried up, where we got a little water by digging holes in the sand. By good luck our guide, Sougou, recognized that we had reached Oued Mourdi, where he had come by another route some six months earlier; thanks to which discovery, after a little search we were able to bivouac beside the well of Diona.

If I had had time and means, it would have been extremely interesting to explore up to its starting-point the great depression I had just crossed, a depression which perhaps comes down from the region of Merga in the heart of the Libyan Desert, where the natives agree in declaring that there exists a little lake surrounded by a palm plantation. The probable position of Merga is between the 25th and 26th degrees of longitude east and 18th and 19th degrees of latitude north. This oasis is situated on the direct route from Ennedi to Dongola, about 200 miles from the last water-point of Ennedi (Gourgouro).

(*To be continued.*)

CLASSIFICATION OF THE GROUND FROM THE AIR

Captain H. A. Lloyd, M.B.E. (late Intelligence Corps)

Read at the Afternoon Meeting of the Society, 8 *February* 1920.

AS a preliminary it should be stated that this paper is based on the experience I gained, as Intelligence Officer to the 9th (G.H.Q.) Wing of the R.A.F., of the difficulties of navigation over enemy territory on the Western Front during the last two years of the war.

The closer co-operation between the army and the air force, brought about early in 1917, by the establishment of special Intelligence Sections on all aerodromes accommodating reconnaissance or bombing squadrons, led naturally to a more careful study of the reports brought back by pilots and observers. It soon became apparent that a large percentage of the reconnaissance and photographic flights undertaken yielded no intelligence.

These failures were due chiefly to three causes: loss of location owing to weather or inexperience; machine defects; and enemy action. It was to combat the first of these that the study forming the subject of this paper was made.

All operations carried out for G.H.Q. began at a distance of more than 15 miles beyond the lines, the G.H.Q. area extending from the 15-mile line eastwards to an unlimited extent, and from north to south from the sea to St. Quentin and at times as far south as Laon.

Several day and night bombing squadrons were employed in this area, but for reconnaissance proper in the whole zone (approximately 10,000 square miles) only one squadron, consisting of eighteen D.H.4 and later D.H.9a machines, was available until about a month before the armistice, when a second squadron of similar strength was added.

The full complement of flying officers was twenty pilots and twenty observers. Owing to casualties and flying officers being sent to Home Establishment for a period of rest the personnel of this reconnaissance squadron underwent a complete change during the course of about every four months.

Bombing flights were carried out in formations of varying size, but reconnaissance flights were undertaken by single machines, relying on their height, speed, and comparative invisibility for their protection. The responsibility devolving on the individual was therefore far greater in reconnaissance than in bombing, where the leader alone, an officer selected for his experience in navigation, was responsible for leading his flight to their objective and for their return. My attention was therefore more directly given to the pilots and observers engaged on reconnaissance work, to whom I had to look for the bulk of the information.

The large area to be covered and the frequent changes of personnel mentioned above made it impossible for individuals to concentrate on and learn any particular part of the area. They were always being sent to fresh places searching for aerodromes, defences, or other enemy works, often well concealed and often, owing to faulty reports of agents, non-existent. Photographs had, however, to be taken of the various places to prove or disprove information received.

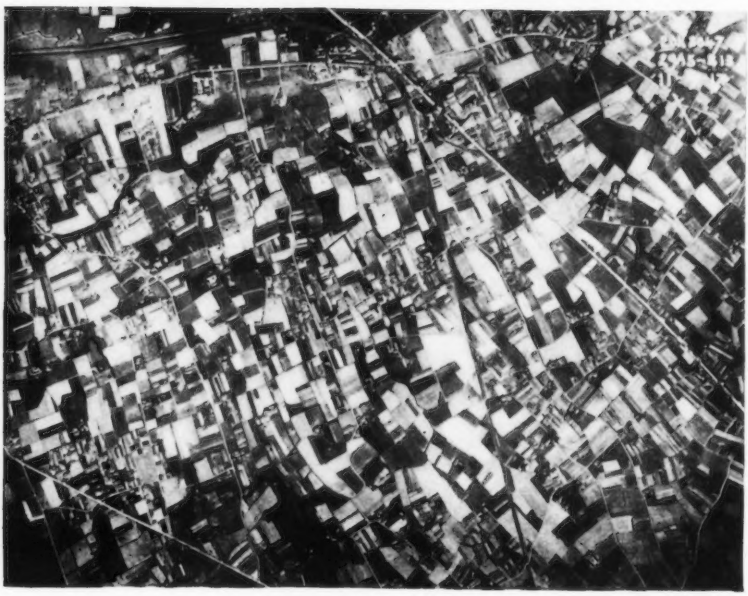
Photographs, when developed, showed that in many cases they were exposed over wrong areas, the aviators having lost themselves and having failed to re-locate themselves correctly.

From the plotting of these photographs, and the many thousands of others taken by the squadron, I found that the whole area could be divided into distinctive zones differentiated either by the shapes of the fields or the industries carried on in particular localities. The limits of these zones were worked out and mapped (see Fig. 1). The pilots and observers were all instructed in the various types of terrain, so that in the event of their losing themselves owing to clouds or other causes they could, even if flying over the country for the first time, form an approximate

"CRYSTALLINE" (No. 1)

PARALLEL FIELDS IN SET DIRECTIONS (No. 2)

PLANTATIONS (No. 3)



"PATCHWORK" (No. 4)

idea of their whereabouts which should enable them to determine readily their exact position.

In the zone with which we are dealing there are thirteen different types of country, each readily distinguishable when seen from 3000 to 4000 feet, and, with two minor exceptions, no one type occurs in two places.

These types exist within the following limits :—

(1) Area Nieuport along the coast to the Dutch Frontier, as far south as a line Bruges–Furnes and possibly under the Yser inundations. Small groups of long narrow parallel fields of arable land adjoining each other in an indefinite manner roughly resembling a crystalline formation. Among this occur much larger pasture fields of irregular shape bounded by wide ditches, giving a somewhat honeycomb appearance. There is a complete absence of hedges, few villages and few isolated houses.

(2) Area on either side of the double canal of Leopold and Derivation of the Lys as far east as the Dutch frontier and possibly beyond. Long parallel fields of similar shape to those described under (1), but all running in the same direction and all changing direction more or less together. There is a scarcity of villages and houses as in (1), and except for a patch in the neighbourhood of Eecloo the fields are not hedge bounded. A small patch of this type occurs halfway between Thourout and Ostend.

(3) Area Bruges–Thourout–Aeltre–Eecloo. Country containing a large number of plantations of young trees. As is to be expected, their boundaries are very definite, and the trees, each block planted at one time, are of fairly even growth, giving, from the air, a "smooth" look quite different from the "rough" look and irregular outline of natural woods or forests which one would expect to see from the conventional green patches on the maps. About 4 miles south of Bruges are found a series of tree-bordered roads which intersect in triangular formation. These are found only in this spot.

(4) Area Thourout–Deynze–Waereghem–Mouseron–Menin. Small fields, most of which approach a square in shape, many villages, innumerable outlying farms, few trees on the stream-banks, and an almost complete absence of hedges. This is best described as a piece of patchwork.

(5) Area south of Eecloo–Terneuzen Canal–west of Scheldt to north of Audenarde. Similar to (4), but the fields are almost invariably hedge bounded.

(6) Large tract entirely east of the Scheldt (with a minor exception west of Audenarde), from Ghent to the small belt of woods north of the Condé–Mons Canal and extending eastwards towards Brussels. The eastern limit of this type is undetermined owing to lack of material. Here the fields are an admixture of types (1) and (4), yet yielding a result quite unlike either. The isolated farms of (4) have become grouped in small clusters with trees round them, and the majority of the streams have wooded banks.

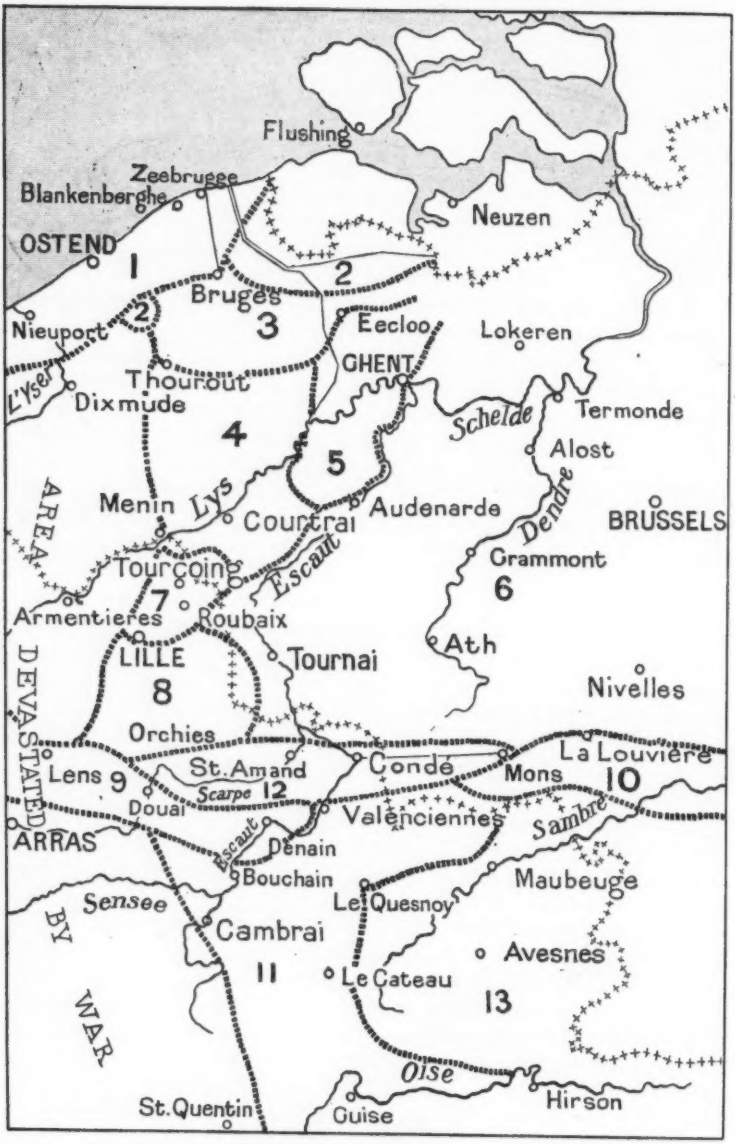


Fig. 1.—Limits of Distinctive Zones

(7) Area Lille–Roubaix–Tourcoing. Manufacturing centres indicated by the large number of factory roofs, both in the towns and outside, the linking up of one town to another by suburbs, and the extent to which the unbuilt land between the towns is divided into small holdings. These small holdings are found round most important towns, and may sometimes be an indication of the proximity of an important place, itself hidden by cloud.

(8) Area Lille–Carvin–north of Douai–Orchies–Tournai. This is an area abounding in small woods. The villages consist of one main straggling street, sometimes 2 miles in length. None of the villages have any breadth.

(9) A long narrow strip 4 to 8 miles wide following the line Lillers–Bethune–Lens–Douai to the western outskirts of Valenciennes. This is the coal-producing region, and apart from the many mine dumps and the complete system of railway communication between the mines it can be distinguished by the innumerable "corons" or garden city estates for the miners. These "corons" are a feature confined to the French coal area.

(10) Belgian coal-mining area. There is a break of about 10 miles east of Valenciennes in the seam mentioned in (9). It reappears west of Mons, passing through La Louviere to Charleroi. This area can be distinguished from the French zone in that the dumps are usually much larger and more irregular and there is an almost complete absence of "corons," the mining villages appearing as a confused mass.

(11) Area south of Douai—south of Denain–Valenciennes—south-west of Mons–Le Quesnoy–Le Cateau–R. Oise–St. Quentin–Cambrai. This zone is the converse of (8). There are practically no woods and all the villages are very compact. The country generally is undulating arable land. The fields are of different shapes, giving a rough idea of a "cubist" picture as opposed to the "squarish" shapes of the fields described in (4). In this area there are two distinct features: the permanently swampy valley of the Sensee river where large patches of water are to be found at all seasons of the year, and a small area of plantation halfway between Cambrai and Denain. These plantations are quite different from those described in (3), appearing in rows rather than in clumps.

(12) Opposed to the permanent swamps of the Sensee river mentioned above there is a strip of pastureland running eastwards from Douai along the valley of the Scarpe to St. Amand, thence to Condé and along the course of the canal to Mons. All this area is liable to flood in varying degrees in the rainy seasons.

(13) Area Bavai–Le Quesnoy–Forêt de Nouvion–Hirson. This part is easily distinguished by the large number of small orchards.

By instructing all new pilots and observers in these different types it was found that they became proficient very much quicker, and reliance could be placed on their reports in a very short time. In several cases

pilots attributed their safe return to the application of these principles. After having lost themselves in clouds they were able to re-locate themselves and take the shortest course home, avoiding a forced landing behind enemy lines due to petrol giving out in a vain search for a known landmark through the clouds.

As the whole scheme has been determined from work carried out under service conditions, it naturally follows that the western limits of all zones have been decided by the battle area. Once cultivation ceases all field characteristics disappear, at any rate to the eye, and almost entirely to the camera. The destruction of battle removes all other features.

As far as is known this system has not been tried in any other area

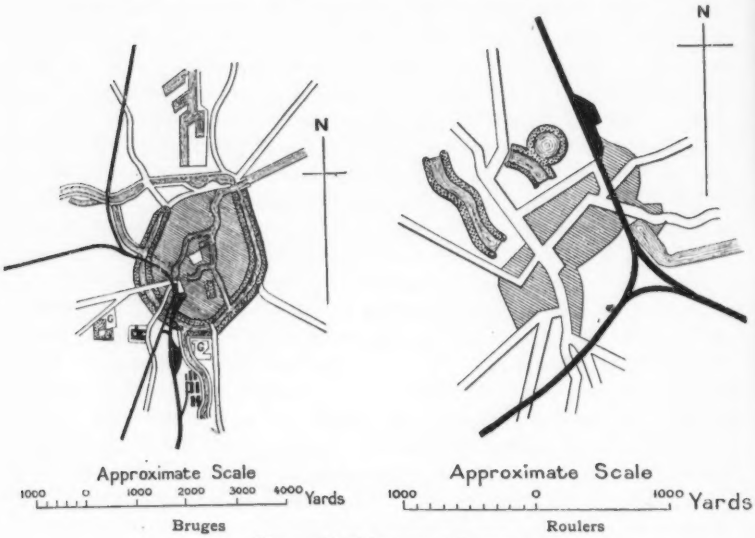
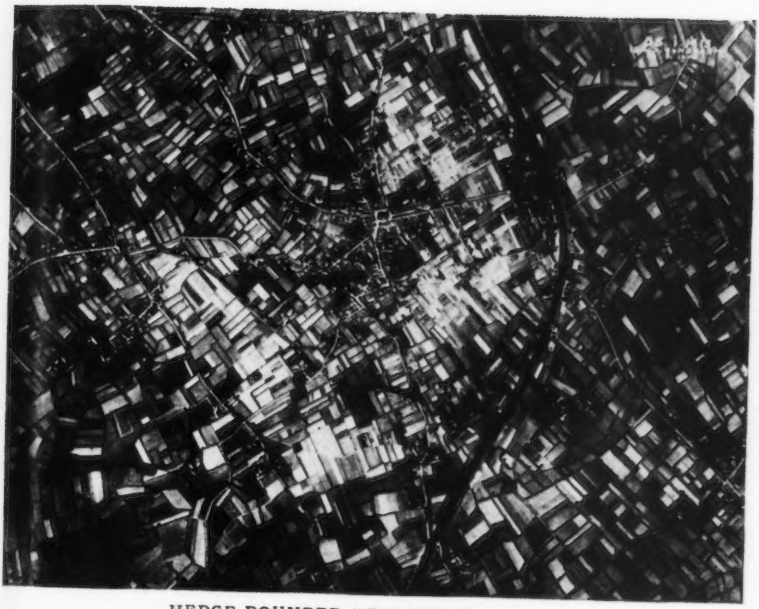


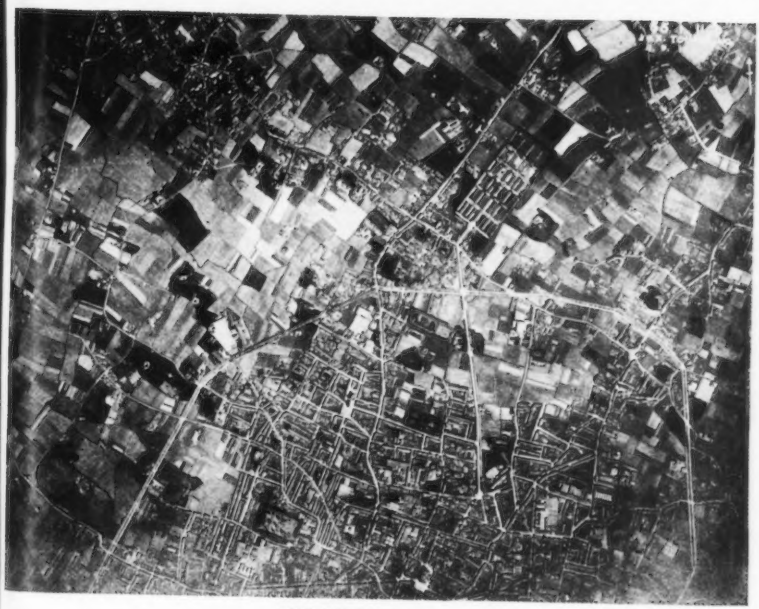
Fig. 2.—Chief features of Towns

than that under discussion, but it is thought probable that these principles would apply to all civilized countries and in rougher detail to uncivilized countries.

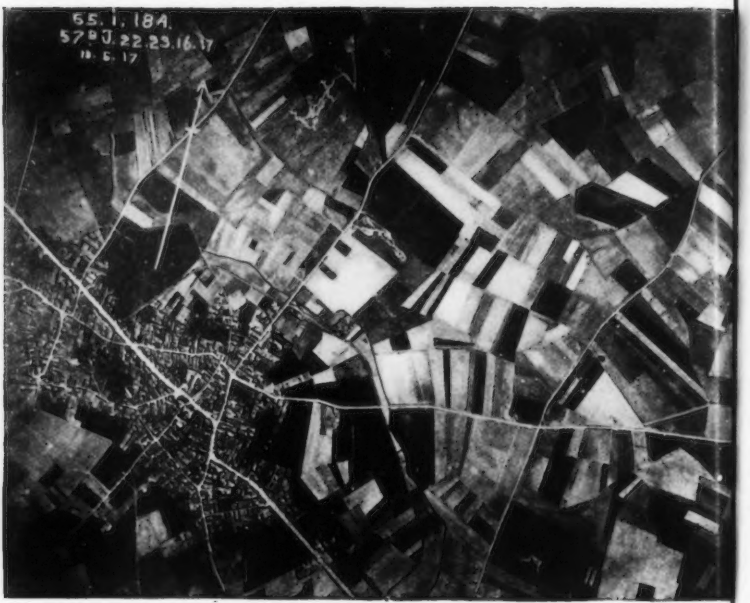
Beyond the classification of the ground which has been dealt with, much attention was paid to the classification of landmarks. Towns which present similar appearance from the air were grouped together and their distinctive features pointed out. Small-scale maps of 1/200,000 or 1/250,000, such as are used for flying, should portray the chief features of the design of towns so that an aviator, catching a glimpse of part of a town through a cloud gap after a long period of flying above clouds, can recognize on his map the main features of the town planning which his momentary glance has enabled him to see.



HEDGE-BOUNDED "PATCHWORK" (No. 5)



INDUSTRIAL (No. 7)



"CUBIST" (No. 11)

PASTURE LIABLE TO INUNDATION (No. 12)

Again, much of the detail on small-scale maps for land use is quite unnecessary in an aerial map. The main features of the country should be taken, and all detail directly related to them included. The remaining detail can be omitted, this leaving a clear map on which outstanding features, likely to catch the eye from the air, stand out boldly.

A portion of map embodying these principles has been prepared and can be seen in the map-room. The different zones are marked off and described. Reproductions of photographs typical of each could be printed on the marginal border if thought desirable.

Before the paper the PRESIDENT said: I have much pleasure in introducing to you Captain Alan Lloyd, who served in the Intelligence Department of the Air Service during the war; he will give us an address upon the methods of classifying the ground as seen from the air.

Captain Lloyd then read the paper printed above, and a discussion followed.

Mr. G. W. YOUNG: I should like to ask one question, whether there is any difficulty at different times of the year in identifying the same area. I thought perhaps these cultivated fields might present a different appearance in the autumn to that observed in the spring.

Captain LLOYD: The only thing that really spoils the face of the country is snow. The different fields change colour but their shapes still remain apparent. On the photograph the degree to which the plate is affected is not dependent entirely on the nature of the growth, but also on its length. You can get a field of green beets looking much lighter than a field of long golden corn from the fact that the long corn absorbs much more light. I have seen a photograph where a field of ripe corn is being cut; the uncut part looks almost as dark as a row of trees. The cut part is quite light, and you can see the little bound sheaves of corn appearing quite white. I have had photographs at all seasons of the year, but I have never actually compared the same fields at different seasons.

Group Captain J. G. HEARSON, R.A.F.: I think the point referred to by the last speaker draws attention to the difference between the picture provided by an air photograph and that which is actually seen from the air. The study of aerial photographs is extremely useful in arriving at what is required in a map to be used from the air, but it must be remembered that there are certain objects which are by no means equally obvious in an air photograph and as seen from the air; for instance, small tracks. The reverse of this is a railway, which is often not very obvious on a photograph, but is always very obvious when seen from the air. Therefore it is necessary to guard against accepting the aerial photograph as the picture which is seen, which does vary very considerably at different times of the year, and this fact makes it most difficult to produce a pictorial representation. One has to adopt conventional signs, but let these signs be as pictorial as possible. The whole way through the lecture it struck me that this point has been slightly lost sight of, namely, the difference between the air photograph and the picture actually seen from the air.

Captain LLOYD: I must say I entirely agree that the photograph is not, strictly speaking, what is seen from the air, in the view of different colouring. The question raised about the tracks is very true. As to railways, I agree with the last speaker, except that my experience of single lines is that they are not

very visible if they are not straight. A short single curved line is not so visible, nor is it on the photograph, of course. As regards the question of the field shapes showing from the air to the same extent as on the photograph, I agree that a photograph puts the picture much more plainly before you. Whenever I have been up flying, I have paid particular attention to this point, to find out whether these things are really practicable, and while admitting that the photograph shows it far more clearly than seen by the eye, I still maintain that even at all seasons, except under snow, the characteristics can be seen. I could find my way anywhere on the front, helped no doubt by my previous knowledge, but providing you know what to look for you will find it.

Commander HOGARTH: The only question I have to raise is about the difference of level. The photographs shown are of a very flat country. How far either does the memory or does the eye distinguish differences of level?

Captain LLOYD: It is dependent very much on the gradient. It is difficult to put a definite level, but I should think at about 5000 feet you begin to lose fairly steep minor contours. As you get higher it practically all goes as flat as flat, but you do see, for example, the steep slopes of the Ardennes or the banks of the Meuse. In some of the hilly country where the Independent Force were working, the contours were seen very clearly on the photographs, but more clearly on the photograph than from the air. Of course if the sun is shining and not too high you have shadows to help you.

Commander HOGARTH: Is there no difference in colour? I was thinking of the extraordinary results in Arabia—the air flattens out everything.

Captain LLOYD: I do not know; I have had no experience of air work except on the Western Front. It depends how the light is falling. The whole thing is the study of light and shadow. You must work it out from that, and you can as a rule.

Mr. HINKS: I think it was in 1912 that the manœuvres in the eastern counties first employed a flying squadron of the British Army. They published a map in which the country was a dark grey and the roads were white, and I was told it was a great mistake then to represent the main roads white, because the tarred main roads were less conspicuous than the second-class roads. I should like to ask whether that is a difficulty. It seems to me something might be done by exaggerating on the map the characteristic shapes of road junctions which must be very conspicuous from the air, and more likely to be useful than any signs or artificial marks.

Captain LLOYD: With regard to the point about the roads, the tarring makes quite a difference—in fact, it was used often as a means of camouflage in aerodromes, where a road crossed or bounded the aerodrome. This especially applies to night flying. Regarding the maps in use, I must say that the map which to my mind meets the conditions best is the Geographical Section, War Office quarter-inch map, N.W. Europe Series, Sheets 1 and 4. It shows more than any other map the differences in the actual shapes of the towns, and gives many of the details I mentioned. On the river Escaut it shows how the whole course has been straightened out through canalization. It gives where the villages straggle along the road and where they are compact in other areas. I have pointed out all the isolated houses in types 4 and 5—that map in that area is studded with little black spots indicating isolated houses, and generally speaking that is the best map I have seen. It is better than the Aero Club de France. In this map I have noticed one point particularly, between Audenarde and Renaix. The ground is shown as practically covered with small woods. I will vouch there are not more than twenty plantations in the area.

Again, all other maps show villages as little circles and do not approach the pictorial design which the quarter-inch gives. The Aero Club de France also gives all sorts of chateaux and windmills. I suppose they are all very well when one is flying low, but after all one chateau is much like another, and there are so many of them that I think there is too much detail put in. The idea is to have the map free of unimportant detail, so that when you see some outstanding or unique feature through the clouds you can find it quickly on your map before clouds close over the gap and you are lost again.

The PRESIDENT: Captain Lloyd has put forward his theory with great lucidity. He has made us understand what are the difficulties of the airman in the air, especially in times of war, and he has given what to us laymen seems a very excellent way of helping out the airman to find where he is. Evidently what we want to do is to hit off some means by which the main features, or at any rate what are the most conspicuous features, in a country can be identified by the airman flying many thousand feet above the Earth's surface, so that when he comes out of the clouds he may be able to know exactly where he is. The lecturer has pointed out that in ordinary good weather it is very easy to find the way with the ordinary maps, but that unfortunately airmen do not always fly in normal conditions, especially here in Europe where there is a good deal of cloud. So what seems to be required are maps which will have none of the unnecessary detail, but will have the conspicuous features perhaps exaggerated, and with some form of conventional sign by which the airman should be able to find his way and identify where he is. You will, I know, wish to give Captain Alan Lloyd a very hearty vote of thanks for his lecture, which we consider of great value to us.

THE EVOLUTION OF THE HASTINGS COASTLINE

Miss E. M. Ward, M.A., B.Sc.

Read at the Afternoon Meeting of the Society, 8 March 1920.

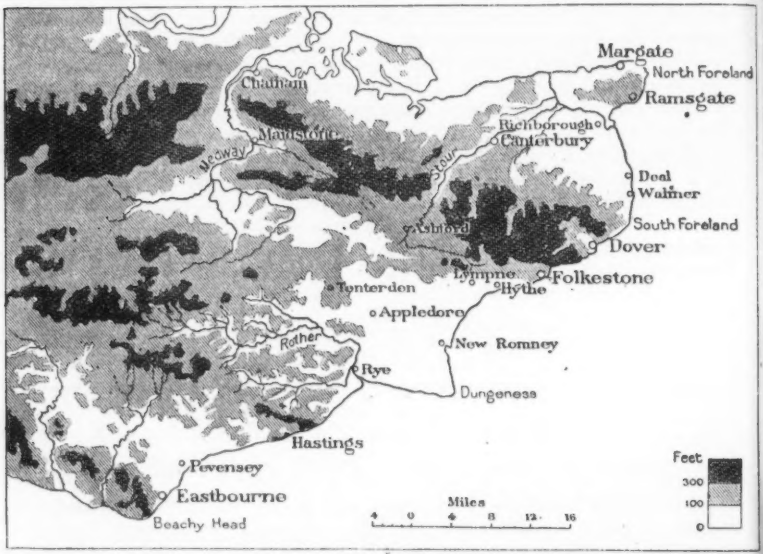
BETWEEN Beachy Head and the North Foreland the eroded Wealden dome is cut short by the Channel. Three hill ridges—the South Downs, the Forest Ridge and the North Downs—end abruptly upon the coast in high cliffs. North of them the low upfold of Thanet is bordered by equally steep but necessarily lower sea cliffs. Between these belts of higher land lie the Wealds of Sussex and of Kent and the flat lands of the lower Stour which separate Thanet from the North Downs. Bounding upland and lowland alike this transverse Wealden coast follows to-day an even line with broad and gentle curves except where Dungeness projects sharply into deep water.

In later Neolithic times the Channel waters washed along a type of coastline very different from that of modern days. The tides ebbed and flowed over Pevensey levels and Romney Marsh, and swung to and fro in the Wantsum strait that lay between a greater Thanet and the mainland. Sheltering the shallow bays that stretched away into the woodlands of the vales of Sussex and Kent the hill ridges ran far out into the Straits. Sea

and land lay interlocked in bays and headlands when Neolithic man dwelt upon the open Downland.

Headland and bay, the one blunted, the other silted up, are gone from the coast. Along the cliffed hill ridges coastlines similarly but more minutely irregular have been submitted to the same changes. The little estuaries and bays and headlands that once diversified the sea margin of the Downs and the Forest Ridge are to-day smoothed out like the greater irregularities of the coastline of which they form a part.

The cliffs of the Forest Ridge extend some 5 or 6 miles along the shore, and in this length are reproduced in miniature the topographical features characteristic of the whole transverse Wealden coast. A detailed



Sketch-map of the Downs and the Forest Ridge, S.E. England

consideration of the course of coastal development here should serve to make clear also that of the main coastline.

Where it meets the sea the Forest Ridge is furrowed by a succession of little valleys. The town of St. Leonards is spread over a series of gentle uplands and hollows, that slope to-day to the inexorable line of the parades. To the east modern Hastings lies athwart the sharply defined Priory Valley that debouches between the Castle Hill and the high ground of St. Leonards. Eastward again the old fisher town is narrowly constricted between the green slopes of the Castle Hill and the East Hill, where the Bourne Valley slopes to the sea. Beyond the old town and the valley of the now vanished Bourne rise the East Hill and the fine uplands that, intersected by Ecclesbourne and Fairlight Glens, and the little valley

HASTINGS FROM THE WHITE ROCK, c. 1817.

HASTINGS FROM THE WHITE ROCK: PRESENT DAY

HASTINGS FROM THE EAST HILL, LOOKING WEST

ECCLESBOURNE GLEN, EAST OF HASTINGS

east of the latter, stretch to the dead levels of Romney Marsh. From the standpoint of coastal evolution the salient characteristics of this length of coastline between Bexhill and Romney Marsh are the cliffed condition of the coastal uplands; the existence in the Priory Valley of a flat alluvial tract now occupied in part by the Alexandra Park, and which follows the curve of the valley for some 1½ miles inland; the straightness of the existing coast; and finally the presence throughout its length of a sand or shingle beach. The cliffs, where they are not masked as at St. Leonards and in western Hastings by buildings, rise in nearly vertical walls, increasing in altitude from the low clay cliffs at Bexhill, to some 200 feet at the Castle and over 300 feet near Fairlight. Cliffs prove coastal recession, and these various headlands must once have projected further seawards. The alluvial tract of land in the Priory Valley, still below high-water level, was once an arm of the sea. The little river Asten which now flows out by a sluice through the shingle banks at the western end of St. Leonards was similarly estuarine. The even coastline of to-day is then a geologically recent development, and has evolved from the originally irregular shoreline of projecting headlands and tidal valley mouths.

At the close of the coastal subsidence which took place in Neolithic times, the uplands of the Forest Ridge undoubtedly extended further seawards, but since the depression allowed the sea to flow up the valley of the Priory Brook—a feeble stream of origin geologically recent and thence unlikely to possess a long and level lower reach—for a distance of 1½ miles from the existing coast, it would seem that the headlands on either side can at this time scarcely have projected more than 1 or 2 miles beyond their present position. The vale of the even smaller Bourne debouches at sea-level, so apparently does Fairlight Glen, though here the stream emerges to the beach through landslip debris. At Ecclesbourne Glen the waves, working more rapidly than the tiny rivulet could deepen its bed, have cut back the mouth of the valley so that the stream falls over a little cliff perhaps 30 feet on to the shore; but this may not imply any great recession, since here again it seems highly improbable that this streamlet should have had any but a relatively steep course.

The rate of recession of the Fairlight Cliffs at a few points of most rapid retreat has for the past thirty years averaged at least 3 feet annually (P. H. Palmer, M.INST.C.E., Borough Engineer). This may have been less in the immediately preceding past, as before the Hastings groynes held up the longshore drift from the west, a shingle beach must have helped to protect this part of the coast. Writing in 1851, Redman (*Min. Proc. Inst. C.E.*, vol. 11, "On the Alluvial Formations and Local Changes of the South Coast of England") states that shingle extended at that time, except across the harbour mouths, from Langley Point near Eastbourne to Dungeness. Supposing the present maximum rate of recession to have been the rate for the whole headland since the close of the Neolithic depression, these cliffs would have receded 2 miles in the 3500 years that

Reid ('Submerged Forests,' Camb. University Press) has estimated have elapsed since then. That they can have projected some 7 miles further out at the commencement of the period of unchanging sea-level, as Gulliver ("Dungeness Foreland," *Geographical Journal*, vol. 9) has suggested, seems at variance not only with the sea-level outfall of the local streams, but also with the observed rate of retreat of the cliffs. Estimates as to the extent of the early projection of these headlands may vary; as to the fact of their former extension seawards there is no doubt.

At the present day the lengths of cliff coast in this region are being actively cut back wherever they are not artificially protected. West of the monotonous lines of parades that extend from St. Leonards to the fisher town, the clay cliffs on either side of Bexhill are rapidly receding; the parades themselves—massive and fronted by great stone and timber groynes—are protected against the sea as elaborately as a fortress against an enemy, and yet suffer damage in great storms. Opposite the fisher town the breakwater of the latest (and seventh) unsuccessful attempt at harbour construction, built in 1893, is already falling into ruin. Beyond the last sea wall east of Rock-a-Nore, the cliffs retreat ceaselessly before the waves. Landslips, concave to the sea, extend inland across cliff paths—the early coastguard station at Ecclesbourne has been washed away, and the new (and now deserted) coastguard cottages are already in danger. The steps down to the shore from this glen have recently been destroyed, and a vertical cliff now makes communication between the glen and the shore impossible.

The conditions at the close of the period of changing sea-level can only be deduced from existing geological and topographical features. Not until the days of the Saxons is it possible to gain from human records some idea of the character of the coastline. By now the town of Hastings had come into existence. It appears to have stood—though the town itself and most likely its actual site are long vanished—on low ground at the mouth, and probably on the western side of a river-like estuary that still, as in Neolithic days, stretched inland between the slopes of Priory Valley. Above the estuary on the east the Castle Hill extended both further seawards and more to the west than it does now. On the opposite side of the haven, and immediately west of the prosperous town, the land rose again and projected out to sea in the bold and rocky headland, now vanished, of White Rock. This high ground forms to-day the area between Hastings railway station and Warrior Square. West of White Rock the coast must have consisted of low cliffs and small bays where the gentle undulations now covered by the grey streets and houses of St. Leonards ended on the shore, and somewhere along here or further westward must have lain the wandering outlet of the Asten estuary. The little Bourne Valley, to-day only some 2 miles long, was evidently not occupied like its western neighbour by the sea—since the town that a little later grew up here appears to have had no haven of its own and to have been dependent on that of the Priory Valley.

Again judging from the present rate of coast recession, the cliffs of Fairlight and those to the west may have stood at this time perhaps half a mile seaward of their present position, and small estuaries may still have survived at the mouths of the various little glens.

Before briefly considering the known course of development of the Hastings coasts since the time of the Saxon town, it may be well to review, very shortly, the local movements of the inshore waters which have brought about that development. Sub-aerial weathering may be neglected as common to coasts and countryside alike, its increased efficiency along the land margin being dependent on the work of marine forces.

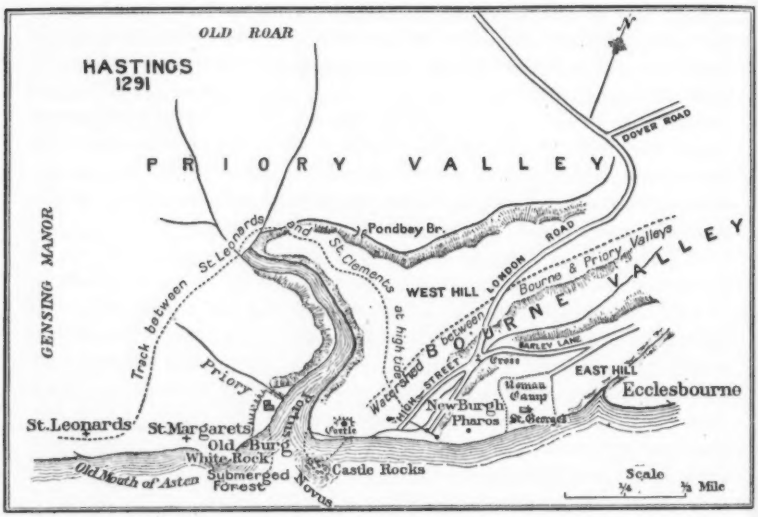
Here at Hastings the coast is exposed to the attack of very heavy storm-waves. The largest and most destructive waves are caused by south-west winds. Winds from south or west blow for nearly half the days in every year, and of the total number of gales annually over one-third are from the south-west. The tidal range reaches a local maximum on this part of the coast, and at spring tides the line of breaking waves rises and falls through a vertical height of 24 feet. Moreover, the size of the Atlantic waves driven from the west and the shallowness of the Straits must ensure a slow degradation of the sea bottom even beyond the inshore zone of more active wave-action. Thus conditions exist not only for effective attack on the land margin, but also for the maintenance of that attack.

The tidal wave, here as elsewhere in our shallow waters, is one of translation. The tidal streams that pour ceaselessly to and fro through Dover Straits seldom exceed, offshore, a speed of 3 knots per hour on the surface, and 2 knots on the bottom. Their direct effect on erosion is probably negligible. But currents of even such comparatively low velocities can transport sand, and move pebbles of about 1 inch in diameter. Very generally the eastward tidal stream flows more rapidly and lasts a shorter time than that towards the west; hence a dominant drift of coarser débris towards the east might be expected. Off Hastings, the east-going stream runs from about three and a half hours before the time of local high water until about two and a half hours after it—thus, when these times hold immediately inshore, that portion of the beach above, approximately, half-tide level is exposed only to an east-going tidal stream.

The predominant westerly winds, the fact that the largest waves come from the west, and the prevalence of the eastward tidal stream for some hours before and after high water all result in a general drift of beach material alongshore from the south-west towards the north-east. Waves erode the shoreline; obliquely impinging waves, wind-generated currents and tidal streams urge the products of erosion north-eastwards. Wave attack and the famous "eastward drift" have been and remain the two great factors in the development of this coastline. From their continued operation there would normally result a general recession of the coast, accompanied by the relatively rapid retreat of any projecting headlands and the formation of barrier beaches across the mouths of inlets. The

silting of the enclosed inlets and blunting of the headlands would create a smooth coastline fringed by eastward-travelling beaches and of gently curving outline so adjusted to wave attack that lowlying and upland shores give way at equal rates before the sea.

We may now briefly trace the development of the coastline as it has been recorded in historical times and see how far that development accords with what theoretical considerations would lead one to anticipate. The coast of the Bourne Valley has suffered relatively little modification. The town at its mouth was founded in the eleventh century, and appears, as already stated, to have had no estuarine haven. Both headlands at the outlet of the Bourne have been greatly eroded by the sea. The Castle Hill may be more conveniently considered later. The East Hill is now



protected by a sea wall and groynes; shingle has accumulated below it, and various buildings stand at the foot of the sheer cliffs that comparatively recently were washed by the waves. The low land at the mouth of the valley is reputed to have suffered some early loss, but the town itself, whose walls extended almost to the beach, was not apparently encroached upon, and to-day a wide bank of shingle, bearing huts for fishing-nets, and capstans, extends in front of the town, which itself has expanded seawards from the line of its old sea wall.

The Priory Valley has had a more eventful history. The Saxon town of Hastings, on the western side of the entrance to the Priory estuary, had by the eleventh century declined from the great importance to which it had attained in the reign of Edward the Confessor; a decline attributed in part to the ravages of the sea. It appears from a record of the bursting

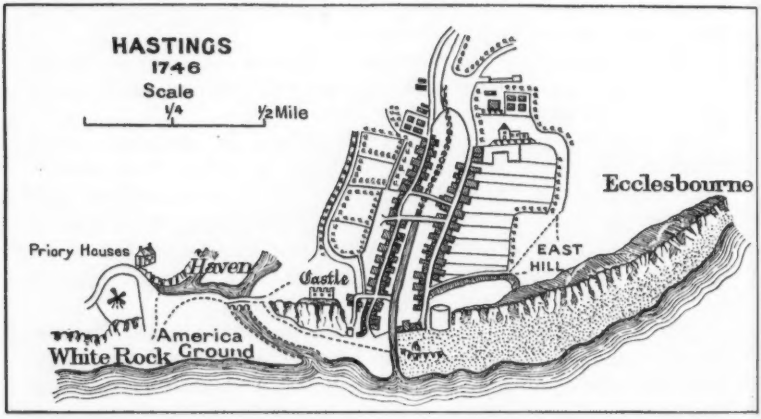
of embankments in 1325 that it was dependent on the protection of sea walls, and was thus built on low ground. Probably, therefore, sufficient shingle had already drifted round White Rock to allow of the silting and reclamation behind it of an area to windward of the estuary. Reclamations on the western sides of river mouths are very common on the south coast, and such areas, unless well defended, are liable to periodic inundation by the sea. By the end of this century the site had become uninhabitable—the citizens had migrated to the new town already established in the Bourne Valley, or to a settlement that grew up, for reasons which will appear later, round the Castle Hill. The Priory building itself stood near the present Hastings railway station, and by 1412 its inhabitants had to abandon this site, which was "laid waste by the sea," and migrate to Warbleton. Thus by this date a lowlying region at the mouth of the valley, an area formerly inhabited, and extending at least as far inland as the railway station of to-day, was either washed away or reduced to a swampy condition.

This advance of the sea upon the low coast of the valley mouth was the necessary accompaniment of the erosion of the headlands that formerly protected it on either side.

By 1440 the parishes of St. Leonards and St. Margarets, which extended west of the White Rock headland, as well as those parishes at the mouth of the Priory Valley, were noted as having suffered great losses by the sea. The Castle Hill was also being actively cut back at this time. In 1236 the original Church of St. Clements, which stood on the edge of the hill, was lost, and by 1331 it is stated that a large part of the Castle was already fallen into the sea.

The Saxon Hastings vanished; its estuarine haven in due time disappeared also. The eastward drift of sand and shingle alongshore, becoming more powerful for reasons which will be discussed later, was by now having a marked effect. By 1380 it is recorded that the outlet of the Priory Brook, and hence the mouth of the haven, was deflected to the utmost limits of its valley, so that the brook flowed out round the foot of the eastern headland below the Castle cliffs. This deflection was caused by a bank of shingle that had drifted from the west round the receding headland of White Rock, and had gradually forced the stream to leeward—a bank that must have lain considerably inland of the present line of beach. A fresh settlement, as above noted, grew up at this new entrance to the haven, founded by migrants from the Saxon town whose site must have become inundated in spite of the growing shingle bank. From this date the Priory Valley itself remained uninhabited—save for some few scattered houses on the hill slopes—until modern Hastings, about the middle of the seventeenth century, began to spread slowly westward from what was by then the Old Town of the Bourne Valley, so slowly that a century later the town still lay mainly east of the Castle Hill. For nearly four centuries, therefore, the mother valley lay silent and depopulated. The

haven, which some records appear to suggest may have become nearly useless for navigation as early as the twelfth century, became finally silted up during the passage of this length of time. One of its entrances seems, from a discovery of an old sluice gate, to have been situated some 300 yards south of Hastings station, or about 200 yards inland from the modern line of the parades. In the sixteenth century attempts had been unsuccessfully made to repair the haven, and at this period a considerable tidal inlet still existed. In 1635 a final scheme for reopening the old harbour came to nought, but a map of 1746 still shows a haven marked in the neighbourhood, and rather south of the present Hastings station. Though its usefulness as a harbourage diminished and finally disappeared, the area occupied by the old estuary long remained an amphibious region, useful neither as land nor water. About the end of the eighteenth century high tide still extended a mile or so up the valley, the site of the present

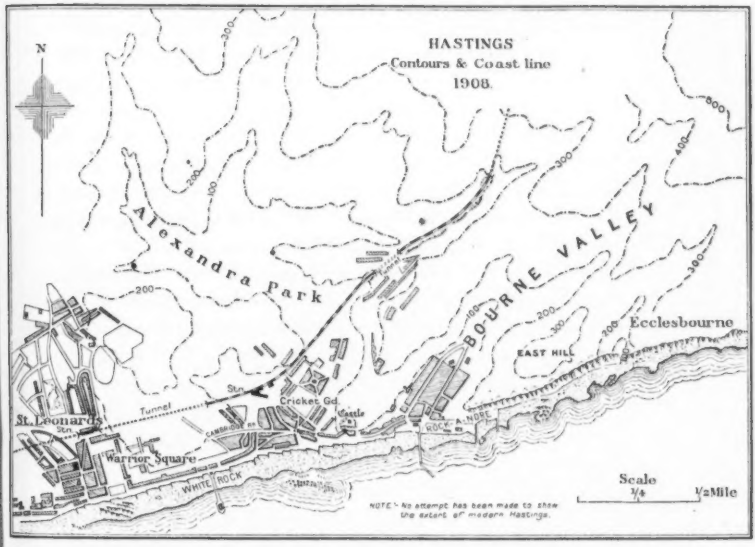


railway station was occupied by a "boggy reed bed," and that of the Cricket Ground by a pond. Two lagoons lay behind the shingle banks, one on either side of the Priory Brook. By 1823 these lagoons had vanished and the eastern one was built over (A. Ballard, 'The Sussex Coastline,' Sussex Arch. Coll., vol. 53).

The silting and reclamation of this estuarine tract took place behind a widening belt of shingle. The map of 1746 shows the Priory haven, separated from the sea by an area of land then known as the America Ground, which extended eastwards from the headland of White Rock. Across the eastern end of this area the Priory Brook communicated with the sea, spanned where it left the haven by the Priory Bridge. On the site of the Priory Bridge stands to-day the Albert Memorial. The tract of land enclosing the haven lay between the present Cambridge Road and the sea, and consisted, as it does still, of shingle. In 1746 it was still an uninhabited and waste area, but by the early nineteenth century it was

partly built over, and in 1850 the present streets and parades were first laid out. It was behind the widening shingle banks of the America Ground that the old estuary, now become a marsh, was gradually reclaimed. The area round the present railway station was drained in the middle nineteenth century, and certain roads were raised above sea-level with material from the railway tunnels. Now the former haven and the shingle area of the America Ground are alike indistinguishable from the rest of the town, though in storms the sea still flows up the old course of the Priory Brook—which to-day runs under the streets and flows out through a culvert—surrounds the Albert Memorial and penetrates as far as the Cricket Ground, some 300 yards inland.

The erosion and recession of the headland cliffs that was already



marked in the earlier stages of the silting haven continued throughout its further decline. Plentiful proof exists of the continued erosion of the St. Leonards coast and the White Rock headland. From old prints and maps and local tradition, it appears that a rough road at one time ran on the beach below this craggy headland towards Bexhill, but by 1833 this road, that must always have been liable to periodic inundation, was gone and the headland itself much broken up by storms. The following year the townsfolk, being possessed no doubt of orderly minds, had the picturesque rocky point removed and the cliffs cut back to make room for the present singularly uninspiring White Rock Parade. The site of the old headland is marked by the present curve in the edge of the parade at the east end of the Baths, and until groynes were erected the waves

continued to attack the sea wall here, which was frequently damaged, as energetically as they had assailed the beautiful headland. The groynes had accumulated by 1878 so much shingle that the promenade at this point was widened and the Baths built seawards of the original sea wall. During the nineteenth century the main coast road through St. Leonards west of White Rock was diverted inland, and Martello towers built in 1805 were washed away.

Up till the fourteenth century the cliffs beneath the Castle were freely attacked by the waves, but towards the latter part of this century, as has been seen above, the deflected Priory Brook and the shingle bank that constrained its course stretched round the base of the Castle Hill, though the breadth of shingle that from this time gradually accumulated between the cliffs and the sea was not built upon until about the same period as was the America Ground. George Street grew up in the middle of the seventeenth century along the more sheltered eastern base of the Castle headland, but the strip of shingle below the face of the cliffs directly fronting the sea was not built upon until later. By 1800 only a few houses stood along it, the inhabited area extending westward as time went on. Here, as on the opposite headland, the cliff face, broken up by wave erosion and weathering, was cut back to make room for terraces of houses, and now the shingle tract below the Castle cliffs is entirely built over and protected by the inevitable sea wall and groynes.

The building, in 1812, of the Marine Parade below the more easterly part of the Castle cliffs was the beginning of the modern series of sea walls and promenades. By the middle of this century the whole length of shore from St. Leonards to the old fisher town was protected. Before the nineteenth century attempts at harbour construction and coast defence were limited to local and isolated schemes, soon demolished by the sea. Probably only for the last hundred years or so has the course of coastal development here been effectively modified by human interference.

A consideration of the development of this short length of coastline brings certain salient points of coastal evolution into prominence. It is known that the last considerable change of sea-level here took place in Neolithic times, and resulted in the deeper submergence of the land. From historical evidence it is clear that the time which elapsed between the close of the period of depression and the growth of the first town in the Saxon period sufficed only for the commencement of the sea's work upon the irregular coastline. In the tenth century A.D. conditions still approximated more nearly to those of Neolithic days than to those of our own times—the headlands were no doubt cut back considerably, but the results of such recession on the valley outlets can only have been beginning to appear. The irregularity of outline characteristic of the early stage of its development influenced the attack of the waves upon the coast of the Forest Ridge. Wave erosion was concentrated upon the headlands, and facilitated by the deposition in the little bays and inlets of the shore waste

which would on a smooth coastline have early begun to encumber the base of the cliffs. The projection of headlands into comparatively deep water interfered with the 'longshore drift of beach material, which drift, in so far as it existed, was confined to short lengths of coastline, each cut off from the 'longshore currents and shifting sand and shingle of its neighbour.

The continued recession of the headlands aided the regularization of the coastal outline in other ways besides that of the blunting of its more prominent projections. Their erosion supplied sand and shingle, and, since the land as a whole rose towards the interior, supplied it in increasing quantities. Their retreat permitted in time the amalgamation of two or more of the previously independent systems of 'longshore drift currents, so that increasing lengths of coastline came under the influence of one dominant drift, here that to the eastward, and were bordered by beach material drawn in part from increasingly distant sources. White Rock headland probably acted as a more or less perfect "drift divide" under whose shelter the tide ebbed and flowed comparatively unhindered in the Priory estuary. By the fourteenth century however, as we have seen, the valley mouth was barred across by shingle banks. Their position in line with the coast and across the estuary was determined mainly by the inertia of the 'longshore drift. Their extension from west to east athwart the estuary implied that a length of coastline to windward had been so far smoothed as to allow of a flow of shore waste eastward from considerable distances round the receding crags of White Rock. The growth of the shingle spit across the tidal fairway of the estuary, opposed increasingly by the flood and ebb currents through the narrowing opening, only became possible when beach materials travelled along the spit, to be deposited at its head, in greater quantities than could be removed by the scour of the tides or supplied by a restricted length of shoreline. By this time shingle from distant sources may have contributed to the Priory spit, since it is probable that the banks across the mouth of Pevensey Bay by now permitted the 'longshore drift of shingle formerly here obstructed. Eventually the Priory spit forced the narrowed outlet of the estuary right against the Castle Hill, and apparently a more or less stable condition ensued, shingle from the west crossing without as a rule permanently obstructing the outflow channel and continuing round the base of the Castle cliffs towards the east. Normally a channel such as this would be entirely choked at intervals; be accompanied by one or more similar tidal gaps at other times; and be subject to constant changes of position, any established channel moving always with the 'longshore drift towards the east. Records of such changes at Hastings are however not known to the author. Behind the shingle banks the estuary soon became silted. It was small and shallow, and could at any time have had only a small volume of tidal waters entering and leaving it. Now it was cut off from the tides, and twice daily its seaward flow was stilled when high water

lapped against the outer shingle banks. Into its always quiet waters the little hill streams brought their burden of silt. Thus it became steadily shallower, marsh vegetation grew up, and at last man intervened and by finally barring out even the greater storm waves and draining the swampy valley floor created a land area fated by his action to remain at the level, rather below that of high-water mark, to which it had risen when he put a stop to further deposition.

The period occupied by the silting of Priory Valley was on the open coastline one of cliff recession. The growth of beaches in coastal embayments probably commences with the first wave attacks on the coastline, but cliff beaches are a later development and only become relatively permanent when the waves have cut at the cliff foot a coastal shelf of such a width and slope as to allow of the deposition and retention of beach upon it. Thus on this coastline in the fourteenth century the sea still washed the base of the Castle cliffs when the Priory Haven was already barred by shingle. Before any continuous system of sea walls or groynes was created at Hastings the cliffs were everywhere so far receded as to be fringed by shingle beaches, narrow however compared with those opposite the Priory and Bourne valleys.

The latter vales had by the middle of last century developed wide areas of shingle before their mouths. The America Ground, as we have seen, had grown seawards from the original shingle spit that had barred the Priory Haven. This widening of the shingle deposits was due either to the accumulation of beach travelling from the west and checked from at once continuing further by the tidal Priory Brook, or to an outward swinging of the line of 'longshore drift owing to changes in the coast to windward, which must have given it its direction. The wide beach in front of the Old Town may similarly be due to the 'longshore drift currents which, increasing in inertia as they gained in volume with the regularization of the coastline, may have ceased to follow the actual coast of the slight embayment and extended in a more direct line from Castle Hill to Rock-a-Nore. In any case such widening shingle deposits grow outwards until the amount washed away from their more exposed and probably longer coastlines equals that brought by the 'longshore currents. Such a state of stability would appear to have been attained at Hastings. It must be remembered, however, that the present system of groynes, which prevent any 'longshore drift of shingle beyond Hastings to the east, has in modern times materially increased the width of shingle beaches in front of the town.

Prior to the present groyning the whole coast of the Forest Ridge was, as has been stated above, fringed by beach. Moreover, the alternations of ridge and vale had ceased to be marked by any corresponding irregularity in the coastal outline, except for the almost silted Priory estuary, before human constructions effectively interfered with natural processes along the coast. Here, then, an irregular coastline of submergence with headlands

projecting beachless far out into the channel and narrow estuaries winding up the miniature valleys, has been reduced since the Neolithic period to the present even shoreline cutting straight across the ends of ridges and valleys, and everywhere fringed by a continuous line of beach deposits.

A similar development of the coastline between Beachy Head and the North Foreland has taken place during the same lapse of time. Towards the close of the Roman period in Britain the eastern portion of Romney Marsh had been reclaimed, but the sea still penetrated far inland over the western portion. Anderida, which later became Pevensey, was a tidal harbour. Richborough and Reculver stood at either end of the still navigable Wantsum. Dover, like Hastings, was originally on a small estuary. At Dover the Dwr flows out at sea-level between chalk cliffs, and its mouth was probably yet estuarine though already greatly silted. By the Norman Conquest coastal development had advanced further, with most marked results on the bay areas. No fresh reclamations had taken place in the main area of Romney Marsh, but certain areas had been reclaimed at the base of Dungeness. This shingle foreland had begun to form at an unknown date from the banks extending across the wide estuarine bay. Pevensey harbour remained tidal though the shallow bay was silting rapidly. In the reign of King John, Pevensey applied for a licence to build a new town nearer the sea. Sandwich had grown up seawards of Richborough on the silting Wantsum. All traces of an estuary at Dover were extinguished.

The main headlands since the Roman period have been altered rather in form than in position. The Roman ports of Ramsgate and Dover are still in existence. If Hastings were not a Roman settlement it has nevertheless been a port since early Saxon days. The headland cliffs have been cut back into an even line, but erosion has not proceeded so far as to remove much land at the mouths of the former inlets.

Silting of the three great areas of submerged lowlands has brought about more notable changes in the coastal outline. Space is lacking to detail here the various stages by which they became obliterated, but fairly full records exist of the advance of deposition and of reclamation which left one port after another stranded inland amidst green country. Romney Marsh and Pevensey Levels became gradually entirely silted behind their shingle banks. The northern arm of the Wantsum was early choked; the southern reach was first partly enclosed by a shingle bank which grew south from the Thanet shore and pushed the tidal channel south with it. On either side of this constricted channel there grew up Sandwich and the vanished town of Stonar. Later sand drifting from the south-west spread between Sandwich and the sea, and continued northwards until the only communication between that town and open water was by a tortuous channel flowing out under the Thanet cliffs.

Viewed broadly, it is clear that a similar development has taken place for this transverse coast as a whole, as in the case of the cliffs and inlets

of the Forest Ridge. Headlands have been eroded, and embayments silted behind shingle banks. A regularized coastline such as this presents none of the variety of deposition forms which it possessed at one time, and which still exists in regions where each inlet or pronounced bend in the coastline gives rise to spits and bars, not yet obliterated by silting of the inlet or blunting of the projection. Here are found no such examples of growing, stable, and eroded shingle spits as occur, for example, on the south coast west of Beachy Head. The shingle foreland of Dungeness has, however, not yet reached a state of equilibrium. It is still extending its point seawards, while Langney Point has ceased to grow, and is now retreating before the attack of the waves.

A study of the evolution of a submerged and transverse coastline like that of the eastern Wealden area affords an excellent preparation for the consideration of coastlines whose topography does not admit of so symmetrical a course of development. Submitted nearly everywhere to a somewhat similar movement of depression at the same period as the Kent and Sussex coasts, the shores of England and Wales have responded in ways as various as their structure and topography to the moulding action of the waves. Certain resistent lengths remain relatively unchanged; some few regions have attained a stage apparently further advanced than that reached by the transverse Wealden coast. Generally the state of development is rather behind that of this region. Each type of coastline presents its own problems—problems which are the more easily solved since lengths in almost every stage of development are available for comparison. The author is at present engaged upon a book, now nearing completion, in which the subject of coastal evolution is considered as applied to the shores of England and Wales.

Before the paper the PRESIDENT said: I have now to introduce Miss Ward, who was a student of geography at the Liverpool University under Prof. Roxby, and a tutor in geography at Liverpool for three years. She has made a special study of coast erosion, and she is going to give us this evening a lecture on coast erosion near Hastings. She is, I think, very shortly bringing out a book upon this subject which will be of great value and interest to us.

Miss Ward then read the paper printed above, and a discussion followed.

Dr. J. S. OWENS: It is with great pleasure that I listened to Miss Ward's paper, as it is very unusual to meet a lady who takes such an interest in this subject and deals with it in such a capable manner. There were a few points on which I should like to touch. One is the projection seaward of the cliffs at the commencement of the present cycle of erosion. I gathered that Miss Ward based her calculations upon a period of about 3500 to 4000 years and a rate of erosion of about 3 feet per annum; this gives about 2 miles projection. I think it probable that the rate of erosion at the present day is very much slower than it was in the period immediately following the commencement of the present cycle. First of all, as Miss Ward has pointed out, the erosion of a headland is much more rapid when there is some place for the material to go to. When the bays were there and unfilled, all the material

washed away from the headlands was easily disposed of. Again, one of the greatest protections against the advance of the sea is the accumulated débris from the broken-down shore cliffs. The cliffs did not exist in the beginning of the present cycle, but were formed by erosion, and as the erosion pushed them back the volume of material to be moved increased very quickly with the increase in height. It is from that material that the protection comes, and the rate of erosion must bear some inverse relation to the volume of material to be removed per unit of advance. If a high cliff falls there is an enormous amount of material to be moved by the sea before the toe is again exposed. In the case of a low cliff the period is much shorter, all of which means that the rate of erosion is inversely related to the height of the land. I conclude therefore that the rate of erosion at the beginning of the present cycle was was much more rapid than at present, perhaps three or four times as rapid, so that if we take a rate of 6 feet per annum, which I think would be nearer to it than 3, we should double the projection seaward. Miss Ward mentioned a current exceeding 3 knots being uncommon in the Straits of Dover. A current of 2 knots, the velocity she refers to on the bottom, means nearly 2½ feet per second, which is a fairly powerful current when it comes to moving material. I think it is very dangerous to regard any current which is capable of moving material continuously as negligible, because of the enormous periods which are available for transport. It has been shown—I have done so myself by experiments (British Association, 1912)—that the volume of material transported in ripples by a current along the bottom varies approximately as the sixth power of the velocity. The capacity of a current to move material therefore rises very rapidly with increase of velocity. The ripple formation ceases and ripples are swept away at about 2½ feet per second; but even if this current were negligible alone, when the depth of water is such that the waves begin to touch bottom, you have a combination of wave and current action combined. A tidal current which is unable to move a piece of the bottom alone may move it when a wave is rolling past. A current of 3½ feet per second is capable of moving stones and sweeping sand rapidly along without forming ripples. Reference was made in several parts of the paper to the prevailing drift along the south coast being from west to east. A point not always kept in mind in this connection is the fact that when slack water occurs at about mean sea-level the part of the foreshore from that level to high-water mark is exposed only to the flood current. As the water rises, the direction of the current changes at, say, about mean sea-level and continues to flow in the direction of the flood while the level rises to high water and falls again. There is thus a part of the foreshore never exposed to the ebb current, and consequently the ebb could never produce drift on that part. That is one reason why the drift is from west to east on the south coast; another is the direction of the prevailing wind. I think we may take it that erosion of the coast is the normal condition, and that accumulation is abnormal. If you consider a coast, newly formed or otherwise, it always presupposes a gradient seaward, and if there is any movement of the water on such a gradient it will tend to cause a slipping down the slope of the material forming the land; and that is, I suggest, the natural condition. You therefore always have a natural tendency towards erosion, which in exceptional cases is modified by accumulation, such as when headlands are wearing down and being deposited in bays. Generally speaking, I quite agree with Miss Ward's deductions, but there is one point on which I differ somewhat. There is a reference to "inertia" in the growth of a shingle bank across an estuary.

When a shingle bank grows across an estuary it is due to a continuous supply of fresh material moved along by the operation of oblique waves and currents, and "inertia" applied to such action seems to me somewhat misleading. With reference to the widening of the shingle banks at Hastings, in my experience a widening of a shingle bank always presupposes some obstruction to littoral drift such as may be caused by a headland or groyne. In conclusion, I should like to thank Miss Ward for her excellent paper.

The PRESIDENT: Dr. Evans was not able to be present here owing to illness, but has sent a letter about this lecture which I will ask the secretary to read.

Letter from Dr. J. W. EVANS: I have had the opportunity of seeing a proof of Miss Ward's interesting communication on the Hastings coastline. She contends, I understand, that after the Neolithic depression the coastline of the south-east of England showed numerous bays and promontories determined by the surface contours previously existing in the neighbourhood of the sea, and that these features, whether on a large or small scale, have been subsequently to a large extent obliterated by marine action. She has, I think, amply proved her case by means of a wealth of historical detail, but I doubt whether we can regard the changes that have taken place on this part of the coast as quite typical of those that may be expected to follow such a depression in other cases. The circumstances have been somewhat special. On the one hand, the rocks are comparatively soft and easily broken up; and on the other, the strongest winds, those from the south-west, and the waves to which they give rise, strike the shore at a very oblique angle and carry the beach material rapidly from west to east. In this they are assisted by the flood tidal current that has the same direction parallel to the shore. The fact that the ebb current tends to diminish the effect of the waves is less important, for, as the author points out, it is only present when the tidal level is low. It must be remembered, too, that the destructive and transporting action of water increases rapidly with the velocity, and a short period of violent movement produces far greater results than a longer period of moderate activity. All the evidence shows that it is in periods of high seas and strong tides that the greater portion of marine erosion is effected, and this is nowhere more conspicuously the case than on the south-east coast of England. The work of marine currents must not be despised because they have little action on the sea-bottom under conditions of calm. When the sea is rough and as a result of wave disturbance a considerable amount of material is in a state of continuous or intermittent suspension, a quite appreciable amount of transport will result from even slow-moving currents, and the author very rightly does not leave out of account the eastward drift, due directly and indirectly to the prevailing winds.

Mr. HINKS: I should like to know how it is that the shingle which is being so prominently deposited upon Dungeness manages to escape altogether the Camber sands by Rye, just between Dungeness and Hastings. It always struck me as being very curious that there is a beach of shingle at Winchilsea and a beach of shingle at Romney, and midway between the two is a beach of the very finest sand to be seen anywhere.

Miss WARD: I will reply briefly to one or two of the points raised. As to the suggestion that erosion is nowadays rather slower than it was, I think this is probably perfectly true. I was really more strongly influenced in my conclusion that the headlands cannot have projected very far by the fact that the very small local streams flow out at sea-level, and in the immediate past it is probable the cliffs receded rather more slowly than to-day. Before Hastings

Corporation constructed its present system of groynes there was a continuous shingle beach from Beachy Head as far as Dungeness Point. Recession is thus probably quicker than in the immediate past, but I quite agree that in earlier days still recession took place more rapidly than now. However, I cannot personally accept the view that the headlands projected anything like 6 or 7 miles as has been suggested by Gulliver, because I cannot imagine what can have happened in this case along the lower courses of the streams. As regards the importance of transport by currents, I am quite convinced of that in my own mind if I rather minimized their importance while speaking. With regard to the eastward drift at Hastings, I think the beach is often only exposed to the current of the flood tide which moves towards the east while the tide is rising and sinking above half-tide level. I have found it a little difficult to follow exactly what occurs inshore, but that is not always what takes place. Sometimes you have the flood current coming from the east and flowing towards the west for an appreciable time. As regards inertia of 'longshore drift, I think I got that idea from the Americans. They gave examples from their own coast which bear out their conclusions that it does possess a certain amount of inertia. With regard to the widening of shingle beaches, every one will quite agree with Dr. Owens in his explanation of this phenomenon. One must, I think, also admit that the widening of the beach may occur simply by the alteration of the direction of shore drift by changes in the coastline immediately to the windward.

I admit I have chosen in south-east England a case giving one of the best examples of working out the development of coastlines. Nevertheless, even on coastlines where conditions are less symmetrical you do get an orderly succession of changes which can as a general rule be followed, and there does exist a fairly thoroughly worked-out scheme by which you can foretell the development of most types of coastline from their original condition to what they may be when some considerable way at least through their period of development.

Referring to the shingle which comes across Rye Bay towards Dungeness from Hastings, you get no shingle until opposite Romney Marsh. You have shingle to the west of Rye Harbour. Beyond that you have a beach of pure sand until you come out to Dungeness Point. The only explanation is that the shingle passes through deep water to the point across the bay. I think no one has ever been able to suggest any other explanation. It must pass through the deeper water and across the bay up to the point.

The PRESIDENT: In this Society we usually go so far afield and treat geography on so large a scale that it is of unusual interest to us this evening to listen to the geography of our own island and hear of it in detail. The point which struck me most was the importance of that increasingly effective geological agent—man. We saw what man has been doing on this coast, and in future centuries of course man will be of ever-increasing importance as a geological agent on the coast of these islands. Men are flocking down to the seaside. We are erecting every kind of barrier along the sea-coast—piers and groynes which must in the course of years very seriously affect the drift of the gravel along the coast. That is a very important agency, and perhaps Miss Ward in her book will look a little into the future. We have to thank her for having put before us so very clearly this interesting subject, and shall look forward with special interest to this book which is about to be published. I am sure you would like me to thank her on your behalf for this most interesting lecture.

A NOTE ON THE TOPOGRAPHY OF THE NUN KUN MASSIF IN LADAKH

Major Kenneth Mason, R.E., Survey of India

AFTER the early reconnaissances of the Nun Kun in the sixties, little attention was devoted to the region for many years; only the lower valleys around the base of the massif were visited by sportsmen. In 1898, however, Majors C. G. Bruce and Lucas climbed the lower slopes of the Ganri glacier, and the former crossed the Sentik La on to the Barmal glacier, and followed it down to the Bhot Khol (Major Bruce in the *Alpine Journal*, 1899). In 1902 Dr. A. Neve and the Rev. C. E. Barton ascended nearly the whole length of the Shafat glacier lying to the east of the massif, and during the same year they crossed the basin of the Barmal glacier from Tongul, *viâ* the Sentik La, descending south-westwards into the valley of the Bara Zaj Nai ('Thirty Years in Kashmir,' p. 179, by Dr. A. Neve). In 1904 Dr. Neve again crossed this glacier (*Ibid.*, p. 189).

In 1903 Dr. Sillem, a Dutch mountaineer, explored this region, and reached and photographed the high snow plateau crowning the massif. In 1906 Dr. and Mrs. Bullock Workman visited the district, claimed to have discovered Dr. Sillem's plateau, and made a complete tour of the mountain knot. Unfortunately their work was not based on the few trigonometrical points fixed in the region; their results led to much controversy, and some of them were not accepted. Since those days a certain amount of evidence has been collected on the points of difference raised by them.

The peaks referred to by various travellers are here summarized in tabular form with the accepted values of latitude, longitude, and height, deduced from the triangulation of 1859–60:

New number.	*Name or old number.*	*Latitude.*	*Longitude.*		*Height.*
		° ′ ″	° ′ ″		Feet.
Pk.1/52 C	Nun, Nana, or Ser	33 58 55·8	76 01 31·1	...	23,410
Pk.7/52 B	Kun, Kana, or Mer	34 00 47·6	76 03 22·4	...	23,250
Pk.6/52 B	Pinnacle Peak	34 01 22·0	76 04 50·1	...	22,810
Pk.12/43 O	Snowy Peak "D 41"	33 58 44	75 58 03	...	—
Pk.11/43 O	Snowy Peak "D 42"	33 59 07	75 55 41	...	—
Pk.39/43 N	Snowy Peak "No. 10"	34 00 22·2	75 50 30	...	19,830

It will be remembered that in her published account ('Peaks and Glaciers of Nun Kun,' p. 85), Mrs. Bullock Workman claimed to have ascended to 23,300 feet, to the summit of a peak which she named Pinnacle Peak, and which she persistently referred to as "the second highest peak" of the group. Her heights and this statement were at variance with previously triangulated values, and a review of her results (published in the *Pioneer* of 14 Feb. 1910), pointed out the view of the

Survey of India, namely, that Pinnacle Peak was the third highest, and Kun (or Mer) was the second highest peak of the district.

This was answered by Mrs. Bullock Workman in the *Pioneer* of 6 May 1910; she claimed that her hypsometric height obtained at the summit of Pinnacle Peak and compared with simultaneous observations at Dras, was more accurate than the Survey height.

The question of the height of Pinnacle Peak relative to others of the neighbourhood was decided by the retriangulation of the peaks in 1911, though in 1910 Dr. A. Neve again visited the region and took some observations with a clinometer lent him by the Survey for that purpose. These observations of Dr. Neve were worked out at Dehra Dun, and indicated that Kun was approximately 480 feet higher than Pinnacle Peak.

The original triangulated values made Kun approximately 440 feet higher than Pinnacle Peak, which was therefore believed to be the third highest peak in altitude.

The re-triangulation of the peaks in 1911 from different stations and from a different series than the original one gave the following completely independent values for the three peaks:

	°	′	″	°	′	″				Feet.
Nun	33	58	47·5	76	02	05·6	...	...	...	23,506
Kun	34	00	52·6	76	02	56·2	...	...	...	23,114
Pinnacle	34	01	22·2	76	04	49·8	...	...	...	22,741

The triangles from which these results were obtained were ill-conditioned, especially for the longitudes of the peaks, and the new observations for position were now computed in conjunction with the old. Almost perfect triangles of observation were obtained, and the resulting co-ordinates of the three peaks became:

	°	′	″	°	′	″				Feet.
Nun	33	58	56·3	76	01	30·6	...	...	...	23,357
Kun	34	00	47·8	76	03	22·6	...	...	...	23,220
Pinnacle	34	01	22·2	76	04	50·1	...	...	...	22,742

Here we see that Kun is 478 feet higher than Pinnacle Peak. In fact, in every case, Pinnacle Peak is several hundred feet lower than Kun. These last values agree very well with those hitherto accepted, and although they may be nearer the truth than the older ones, the objections to making changes in accepted values of heights, when fresh evidence produces unimportant variations, are so serious that the original values have been retained in all Survey of India publications. The old height of Pinnacle Peak (22,810 feet) was deduced with a coefficient of refraction 0·05, while that used with the modern observations is 0·07. By using the latter coefficient (0·07) for the early observations, the height (22,810 feet) becomes 22,738, and closely agrees with the new height, the weighted mean becoming 22,741 feet, using 0·07 for all observations. Similarly the old heights of Nun and Kun are in excess of those obtained above,

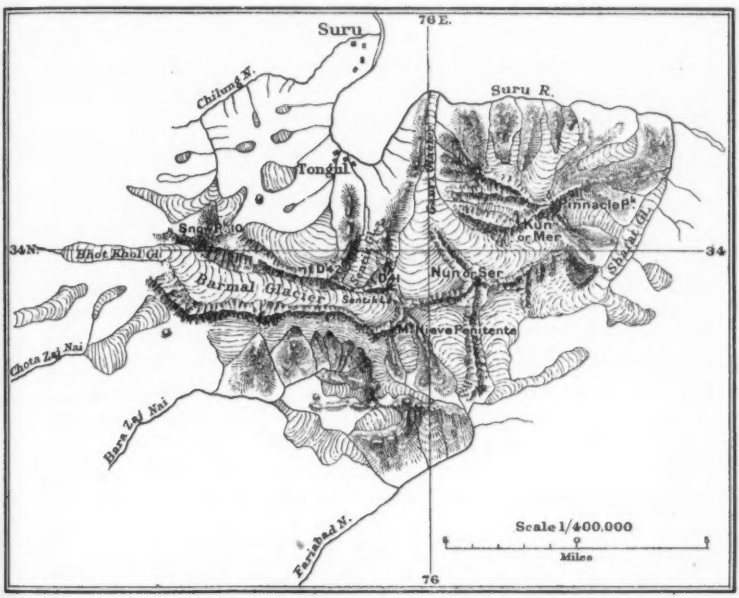
owing to the coefficient 0·05 being used instead of 0·07, and the old observations give heights closely in accordance with the later ones, if 0·07 is used. The point at issue is, however, the relative values of the three peaks, and is unaffected by any adopted coefficient of refraction.

Another point brought out in the review of Mrs. Bullock Workman's book was one originally noted by Major C. G. Bruce after his expedition in 1898, and raised by Dr. A. Neve after his journey in 1902. The old Survey map showed the Barmal glacier rising in a mountainous cirque south of Snowy Peak No. 10 (34° 00′ 22″, 75° 50′ 30″), flowing eastwards, bending north-eastwards immediately west of Peak D 42 (33° 59′ 07″, 75° 55′ 41″), and finally draining into the great bend of the Suru river near Tongul. Dr. Neve pointed out that the glacier rose in a rocky cirque south of D 41 (33° 58′ 44″, 75° 58′ 03″), flowed westwards, south of and past D 42, and, at a point almost due south of Snowy Peak No. 10, it changed direction north-westwards and joined the Bhot Khol glacier. He established the connection of Peaks No. 10, D 42, and D 41 by a rocky wall, asserted that the Barmal glacier was the Upper Bhot Khol, and, perhaps rather loosely, referred to the whole extent of ice as the "Great Western glacier of Nun Kun." No new edition of the Survey map was published, but Dr. Neve's amendment was admitted by the Survey to be probably correct, and it was supported by Major Bruce's account in the *Alpine Journal*.

The Workmans during their visit in 1906 made some notable ascents on the western outliers of the massif, but they did not follow the Barmal glacier down to its tongue, as had been done by Major Bruce. Yet in their published account they accused Dr. Neve of "erasing" the rocky wall south-west of Snowy Peak No. 10, "correctly charted by the Survey," in order to show the Bhot Khol–Barmal connection; and they maintained that Dr. Neve's "assertions were not in accordance with fact," and that the Barmal glacier drained into the Bara Zaj Nai; their map was drawn accordingly.

The Survey of India review, mentioned above, referred to the undeserved reprimand of Dr. Neve, pointing out that at any rate the travellers agreed as to the main course of the glacier, though they differed as to the actual hill-stream into which it drained. Dr. Neve, however, was determined to prove or disprove the correctness of his topography, and in 1910 again visited the district. In a letter from Dras, dated 25 September 1910, he wrote: "We ascended the Barmal glacier from the Bhot Khol and took photos and observations from a point due south of No. 10 . . . I then made a complete circuit round No. 10 *viâ* Bhot Khol, Suru, and then up the Tongul–Sentik route; camped at 17,500 feet on the Barmal glacier, and climbed D 41 in spite of the fresh snow. It was cloudless to the west, north, and north-east, and I got a circle of compass bearings. . . . At the bend of the Barmal glacier south of and west of Peak No. 10, I have three photos showing the continuation of the range on the south and

south-west side (Bara Zaj Nai)." This is the range erased by the Workmans. In his book, 'Thirty Years in Kashmir,' Dr. Neve gives a detailed account of this journey. He mentions that during his early expeditions to these parts he was not aware of Major Bruce's journey of 1898, an account of which had been published in the *Alpine Journal* of 1899. But the conclusions of their two expeditions were identical. In 'Twenty Years in the Himalaya,' Major Bruce gives his account of the Barmal glacier to the Bhot Khol, and on p. 99 he says: "In front of us lay the only question of the tramp: *a large and broken icefall* (see photo)." Opposite p. 100 is the photo referred to. This is almost identical with the



Sketch-map of the Nun Kun Massif

photo in the Workmans' book on p. 148; here, however, this icefall is singularly described as a "glacier-covered mountain wall separating it (*i.e.* the Bhot Khol) from the Barmal which lies on the south of the wall. This is the wall erased by Dr. Neve from the Survey map to indicate the junction of the Barmal and the Bhot Khol."

Major Bruce descended this icefall. Dr. Neve both ascended and descended it. The Workmans only saw it in the distance. Dr. Neve has not only proved that the Barmal is the Upper Bhot Khol glacier, but his photographs also show that there is no drainage outlet from the Barmal into the Bara Zaj Nai, which was the contention of the Workmans.

Dr. Neve also maintained that his assertion that the Barmal glacier

came "all the way from Nun Kun" was justified, since it rises in the cirque formed by D 41, the Barmal Ridge, and Mount Nieve Penitente, the western boundary and buttresses of the Nun Kun massif.

In addition to this, Dr. Neve, from the summit of D 41, found Nun almost due east of D 41, as originally shown on the Survey map (lat. of D 41, 33° 58′ 44″; lat. of Nun, 33° 58′ 56″). The Workmans had stated that D 41 was a mile too far south on the Survey map, and had therefore displaced this fixed point to another position west-north-west of Nun.

It is difficult to place much reliance on maps that have been based on the shifting of triangulated points: probably the only advance in topographical knowledge gained from this expedition of the Workmans was the indication of a route up the "North-west Nala" from the Fariabad Nala to the Barmal glacier; and even here the enclosing of a glacier in an amphitheatre of mountains with no outlet for drainage tends to shake confidence in the topographical details of the map.

To sum up: the alterations which should be made on the map of this district published by the Workmans are as follows:

(1) Pinnacle Peak should be 22,810 feet and not 23,300 feet high.

(2) D 41 and probably the whole glacial basin of the Upper Barmal should be placed a mile further south, as indicated by Dr. Neve.

(3) The connection of the Barmal glacier with the Bara Zaj Nai should be erased (proved by Dr. Neve's photographs), and an icefall connecting the Barmal and Bhot Khol glaciers in place of the mountain ridge should be shown at the bend of the Barmal glacier south and south-west of Snowy Peak No. 10 (proved by Major Bruce and Dr. Neve independently).

(4) The drainage of the glacier south-east of Mount Nieve Penitente should be connected with the "North-west Nala."

From a mountaineer's point of view, the fact emerges that the height reached by Mrs. Bullock Workman was not so great as 23,000 feet.

CLIMATIC CONDITIONS ON THE IMPERIAL AIR ROUTES

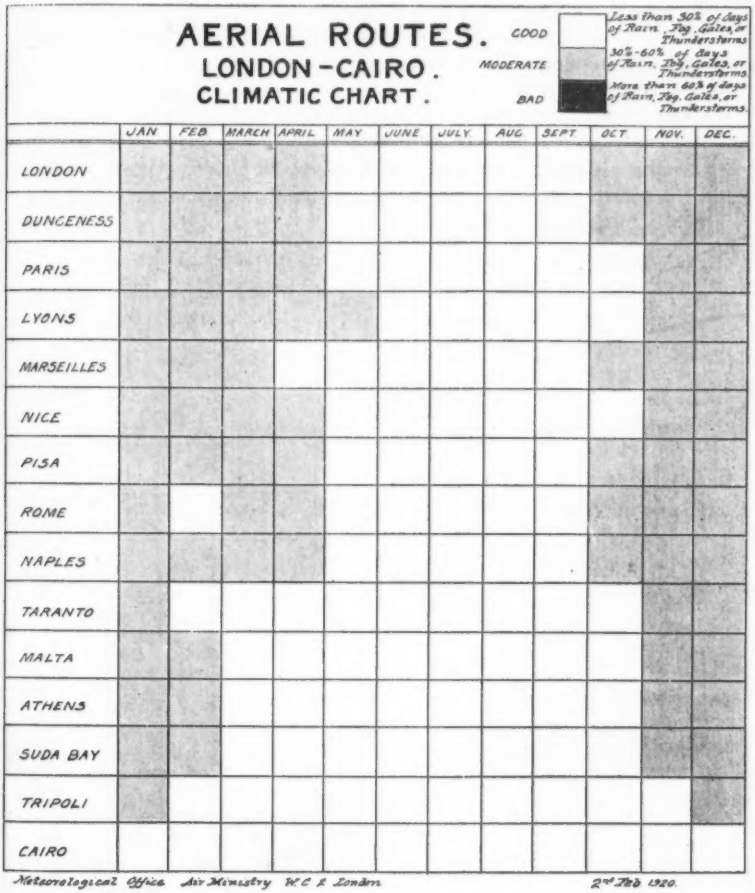
Prepared by the Meteorological Office (Air Ministry), and communicated by the Controller-General of Civil Aviation

THE diagrams here reproduced show by gradations of tint the meteorological conditions month by month along the Imperial Air Routes —the white space representing a month with less than 30 per cent. of days of rain, fog, gales, or thunderstorms, and the light and dark tints months with 30 per cent. to 60 per cent. and over 60 per cent. respectively of such days. The diagrams are only approximate, and bad-weather factors represented by equal tints at different places or for different months are not necessarily the same. Thus the same tint may represent rainfall in one case and fog in another. The diagrams, however, by showing at a glance the

relative weather conditions on a route, indicate the best months for attempting flights.

England—Egypt.

The route may be divided climatically into two sections. That from



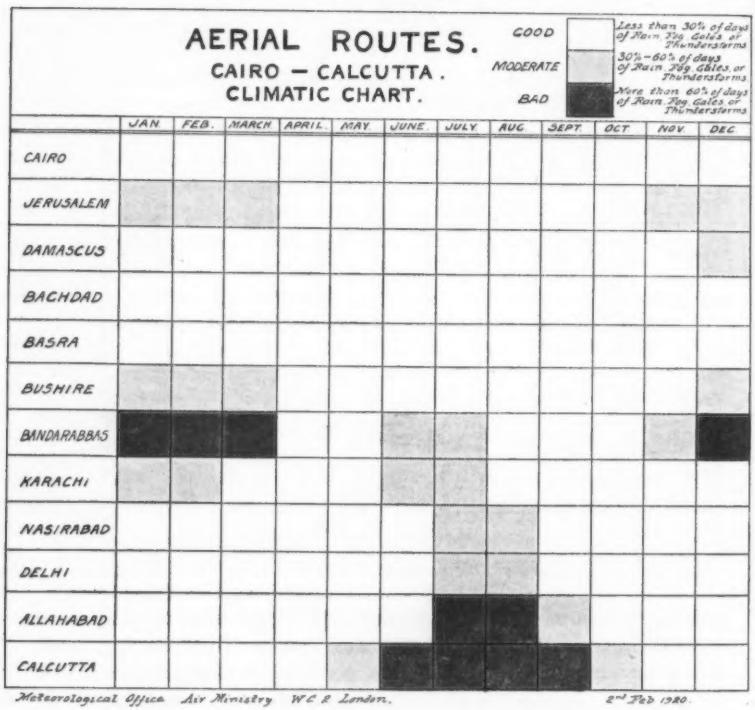
London to Central France is characterized by prevailing westerly winds and liability to cloudy skies and rain at all seasons. In winter, fog, clouds of strato-cumulus type, and gales from directions between south and west are frequent. In summer winds are lighter and more irregular, chiefly west to north-west. The usual cloud-type is cumulus. Severe thunderstorms occur in the French interior.

In the section Central France to Cairo the Mediterranean is in winter a region of low pressure traversed by storms of wind and rain. The winds are consequently very irregular, but are chiefly north or north-west. Severe northerly gales spring up rapidly, especially on the north coast, and may last for several days. Although rain during this season is often greater than that of south-east England, it falls on far fewer days and comes in short heavy downpours, between which blue skies and bright sunshine prevail. Consequently cloudiness is considerably less than in England.

In summer the Mediterranean weather is much calmer. Pressure is high to the west and low to the east, giving northerly winds. Near the coast land and sea breezes are marked. Very little rain falls from May to September, and the sky is almost cloudless, but morning mists develop on the coasts. About the third week in September, summer conditions give way to those of winter.

Egypt—India.

The weather conditions in Northern Egypt are very stable. During



winter (November to February) cloudy weather with occasional rain prevails, the wind being usually south-west. March and April are very hot,

with dusty south winds. During summer (May to September) light north winds prevail, at a maximum in the afternoon.

Over the route between Lower Egypt and the Persian Gulf prevailing winds to a considerable height are westerly, and gales are rare. Nearly all this area is almost rainless, with a small mean cloudiness. In the Syrian coastal region, in mid-winter, gales and rain may occur, and snow falls every winter on the Syrian mountains.

Strong north-westerly and south-easterly winds with thunder, heavy rains, and occasional gales occur in the Persian Gulf in winter. Between mid-April and mid-October bad weather is rare, but the damp heat is excessive and visibility often bad.

From Bandar Abbas to Karachi the monsoon region is encountered. During winter north-west winds and bad weather prevail as in the Persian Gulf. In the north of the Gulf of Oman, bad weather, though alternating with frequent calms, may occur at any time of the year. The south-west monsoon prevails in summer, especially towards Karachi. On the delta of the Indus storms are rare.

Trans-India.

Between Karachi and Calcutta, across the great plains of India, there are winter, hot, and rainy seasons. During the winter season (November to February) the mean temperature is generally below 65° Fahr., and prevailing winds are north-westerly and steady, becoming northerly near Calcutta. Less than one-fifth of the sky is clouded on an average.

The hot season (April to June) is characterized by very high temperatures. Winds are westerly in the Punjab and south-westerly in Bengal, but the skies are very clear. In the dry part of the west whirling dust-storms may occur in the afternoon, and the air becomes very "bumpy."

The rainy season commences very suddenly with what is known as the "Burst of the South-West Monsoon." Some days before the first rainfall the wind shifts to west-south-west in Western India and to south-east over Bengal. The rain-storms travel northward, reaching Bombay about ten days before their appearance in the Central Provinces and Bengal. The mean date of the first rains along the route is June 15, but in the north-east they are much later. After the opening "burst" rainy days alternate with fine days, the reappearance of fine weather being gradual.

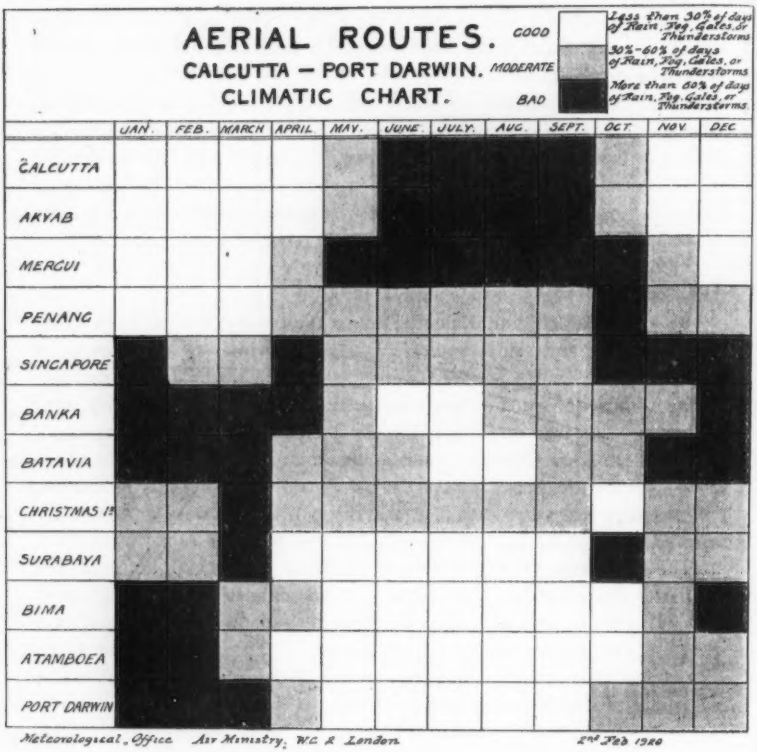
In no part of the journey from Cairo is fog troublesome, and although mist may occur frequently in the morning, it dissipates before 9 a.m.

India–Australia.

In the Ganges Valley and Burma the south-west monsoon from March to August causes very heavy rains, the average rainfall for July and August being three times the annual total of London. During this season there is much cloud, and its beginning and end are marked by heavy squalls and thunderstorms. Cyclones occur in the Bay of Bengal between May

and November, those during October being usually the most violent. They generally strike the coast and follow the Ganges Valley. During the north-east monsoon, which lasts from November to March, there is little rain or cloud.

The East Indian Archipelago has a wet tropical climate, the heaviest rain falling between December and March. Between October and March the mean cloudiness is five-tenths to six-tenths, but during the remainder



of the year the sky is generally clear overhead, though visibility is poor. The monsoon winds extend to considerable heights, and at the change of the monsoons heavy storms are experienced.

Between Timor and Australia a regular storm-track exists and cyclones are usually experienced between November and April.

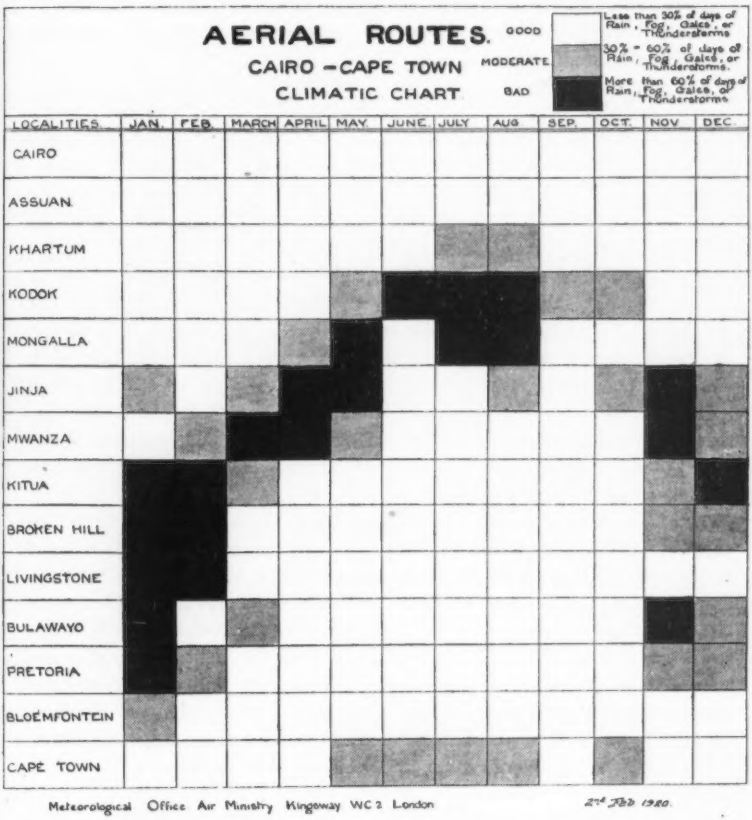
In Australia, the Northern Territory and Queensland have monsoon climates with rain from November to April. The southern portion has a Mediterranean type with winter rain. The Southern Queensland coast is within a hurricane region; these storms usually occur between November

and April. The whole route south of Brisbane is very liable to gales. At Sydney the average in a year is 92.

Cairo—Cape Town.

The route may be divided into three sections:

(1) *Northern Section* (from 31° N. to 5° N.).—The day temperature is very high, the mean daily maximum varying from about 90° Fahr. to 110°



Fahr. In spring and summer the hot dusty Khamsin wind is liable to blow from the southward for a day or two at a time.

This section is divisible climatically into three sub-sections: (*a*) from the Mediterranean to the south of Cairo, (*b*) from Assiut to Atbara, (*c*) from Atbara to south of Kodok.

(*a*) The prevailing wind is north-west, with a moderate proportion of west and south-west winds, but there is a well-marked diurnal variation of

direction. Winds of 30 m.p.h. only occur a few times annually. The upper wind is predominatingly from the west, but the height of this current varies. Extensive cloud sheets occur only in winter. In the delta light winter rain occurs, and in summer and autumn night fog is common on the irrigated lands.

(*b*) The prevailing winds are north-west and north as far as Wadi Halfa, and at all seasons 90 per cent. of the surface winds, which are light, blow up the Nile Valley. The few upper-wind observations indicate an easterly wind above the very shallow northerly one. Cloud sheets and rainfall are almost unknown.

(*c*) From Atbara southward the proportion of winds from other directions increases, down-valley winds predominating in summer (April–September) and up-valley winds in winter. Surface winds are rather stronger. From Khartoum cloud amount steadily increases, but until Mongalla (5° N.) is reached extensive cloud sheets only occur in the rainy season. The rainfall increases from 4½ inches at Khartoum to 40 inches at Mongalla.

(2) *Central Section* (from 5° N. to 10° S.).—This section has a tropical continental climate, modified locally by the lakes. Cloud, storms, and "bumps" characterize the whole region, but especially the lake valley. Except in the latter neighbourhood winds exceeding 30 m.p.h. are very infrequent. There is a well-defined diurnal variation of surface wind-velocity, and at night a dead calm is almost invariable. In the lake districts much stronger winds occur, occasionally attaining gale force. One-third of the days in every month are cloudless. Heavy rain and thunderstorms often occur at night.

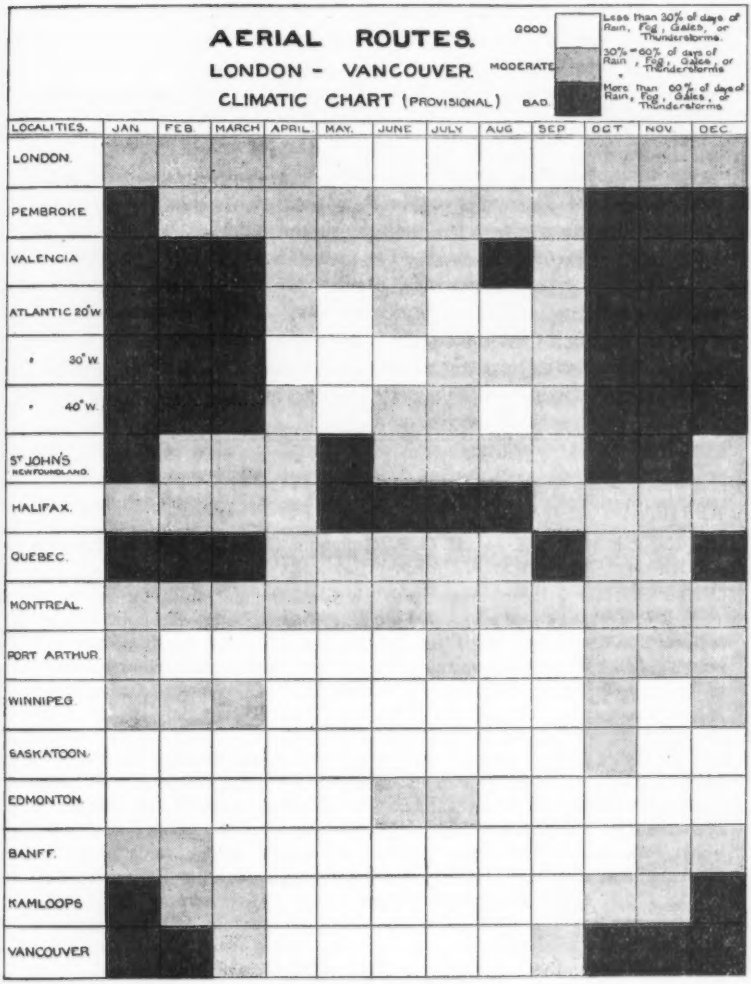
(3) *Southern Section* (from 16° S. to Cape Town).—The chief feature here is the enormous variation of rainfall in different regions. It may be said generally that rainfall increases from west to east and from north to south. Except near Cape Town where winter rains prevail there is a well-marked rainy season in the southern summer, with warm easterly winds from the Indian Ocean. The prevailing winds are light and tend to die down at night on the level plains. The highest temperatures slightly exceed those of London. Severe thunderstorms occur, often accompanied by much hail. Snow is usually confined to the mountainous districts. Dust-storms are frequent except towards the end of autumn.

London—Vancouver.

The chief characteristic of the Northern Atlantic is its liability to sudden changes of weather and to the rapid and frequent springing up of gales and storms. Even in the comparatively favourable summer months occasional gales occur. From October to March the average number of days of gales varies from about thirty in eastern to about sixty in western mid-Atlantic. The maximum frequency occurs in western mid-Atlantic (35°–40° W.) between January and March. Occasionally the

whole of the North Atlantic is dominated by one large system, but usually one or more depressions and anti-cyclones exist at the same time.

Fog is at a maximum during summer, when it may occur on 10 per



Meteorological Office Air Ministry W.C.2. London.

cent. to 20 per cent. of days per month over the eastern and central portions of the ocean. The Newfoundland Banks region is notoriously foggy, and in summer dense fog lasts for several days at a time. Fog

never occurs here on less than 30 to 35 per cent. of days a month, and at mid-summer this increases to 50–55 per cent. over a large area.

There is considerable variation in the climate of the trans-Canadian route, and three sub-divisions may be broadly distinguished.

(1) *Maritime Provinces, Quebec, and South Ontario.*—The summers are warm, with much sunshine and few rainy days: most of the summer rain falls in showers or thunderstorms. Heavy snowfalls occur from December onwards, finally melting about the middle of March. The prevailing winds are westerly, particularly from July to September.

(2) *Southern Manitoba, Saskatchewan, and Alberta.*—These provinces as a whole have the greatest extremes of temperature. The average temperature from December to March at Winnipeg is only 2° Fahr. The rainfall is moderate (15–20 ins.) and the summers hot.

(3) *South British Columbia.*—The plateau between the Rocky Mountains and the coast ranges has a relatively dry climate, with warm summers and cool, but rarely severe, winters. Rainfall is moderate and there is some winter snowfall. The coast region is wetter (annual rainfall at Vancouver 62 inches), but relatively mild, and usually winter temperatures do not fall below 20° Fahr. Prevailing winds are south-westerly.

REVIEWS

AFRICA

The Republic of Liberia.— R. C. F. Maugham, Consul-General at Monrovia. London: George Allen & Unwin. 1920. 18*s*.

WHEN Sir Harry Johnston published his monumental work on Liberia in 1906, it was felt by those who knew the little-visited Negro Republic that the last word had been said about it. The present writer has offered what might be described as a handbook rather than a history, although it follows the lines of the more important book in giving the narrative of the century during which Liberia has been an independent state, reproducing again the Articles of the Constitution, List of Presidents, etc.

The author brings us to 1918 and includes the more recent events, omitting, however, the bombardment of Monrovia by a U-boat, afterwards sunk. The great but undeveloped riches of the country are brought out, also the reluctance of the natives to make use of them. In his sketch of the fauna and flora the writer does not seem quite happy: there are several *lacunæ* which he admits he is unable to fill. For instance, he crosses swords with Johnston as regards the coloration of the dwarf hippopotamus, as well as on other subjects. The ordinary reader will be inclined to side with the older and more distinguished writer's views.

In our opinion the writer fails to bring out sufficiently the fact that, up to the outbreak of the war, Liberia, chiefly owing to the want of support accorded to Englishmen by our Foreign Office, was rapidly becoming a German colony. German trade had secured the upper hand; a huge building had been erected in 1911 for the offices and living quarters of a German Telegraph Company, with a four-cable line to South America. Here were installed some eighty operators. In addition there was a German wireless station. One should

realize that had it not been for the financial aid which Germany gave to the Liberian Government; had it not been for the support—*vi et armis*—which the Germans gave to their traders (witness the landing of German marines in 1911, and the anchoring of the *Panther* off Monrovia with guns trained on the Executive Mansion for a month); had it not been that the German was perhaps a better and more adaptable trader than the Englishman, Liberia was only too anxious, whilst preserving her autonomy, to be altogether on the side of England. These facts cannot be so bluntly stated by an official.

The great drawback to investment of foreign capital in Liberia has hitherto been that no white man can own land, and in addition he is sadly handicapped by the law courts. The new President, C. D. B. King, installed January 1920, of whom an excellent likeness forms the frontispiece of this work, is, however, a far-seeing man who understands that it is for his country's good to invite foreign co-operation in opening up the hinterland, and is disposed to give hitherto unknown facilities for trading, etc.

The book is illustrated by reproductions of photographs and a map issued by the *African World*; but too much reliance cannot be placed on the latter owing to the fact that the hinterland has never been completely surveyed, and consequently many of the towns must have been located at random.

C. P.

AMERICA

An Ethno-geographical Analysis of the Material Culture of Two Indian Tribes in the Gran Chaco.— Erland Nordenskiöld. Göteborg: Elanders Boktryckeri Aktiebolag. Pp. xi., 295. *Maps and Illustrations.* 1919.

This work is an interesting and valuable anthropo-geographical study of the Choroti and Ashluslay, Indian tribes living on the Gran Chaco in the neighbourhood of the Pilcomayo River. Baron Nordenskiöld, in his many earlier publications, has given evidence of his wide knowledge derived from study of the native races of South America. He brings, therefore, to this intensive investigation of the two tribes above mentioned a rich store of information by which their culture can be compared with that existing in other parts of the continent, both present and past, and its sources elucidated. He describes *seriatim* all the fundamental elements of their culture: dwelling, bed, tools, weapons, utensils, dress, tattooing, games, musical instruments, weaving, and pottery, and shows at the same time by means of a long series of maps the geographical distribution of each in the South American continent. In doing this much interesting information is given about the life and habits of the Choroti, Ashluslay, and neighbouring tribes. After each element of culture has been described, its source is discussed.

Having done this, the author proceeds to draw his general conclusions on the extent to which the culture of these tribes has been influenced by the Whites, from the south and from the north, and by the mountain civilization to the west. He very justly points out that the positive influence of the Whites is more evident the further away from them the Indian tribes live; where, in fact, they are beyond the direct debasing influences of civilization. In the case of the Choroti and Ashluslay the influence of the Whites can be traced chiefly in the domestic animals and things connected with them. From the south they have learnt the use of skins and leather; from the north they have received manioc and the arts of spinning and weaving. But by far the most important influence has come from the mountain region in the west. In fact, the greater part of their culture is derived from this region, *e.g.* the wooden spade, tools, weapons, clothes, ornaments, games, musical instruments, and many handi-

crafts. It is an interesting question how far this western influence is Incan or Pre-Incan. On this point the author remarks that "unfortunately the archæological material found in Peru has not, in general, been raised and treated in such a manner that we can say with certainty whether the elements of culture which have reached the Chaco from the west are Incan or Pre-Incan. One cultural element, the water-pot, is certainly Incan." He considers it probable that many of the cultural elements did not reach the Chaco from the west until Incan times, because of their not being widely distributed in the eastern part of South America.

A still more interesting question is whether there was any ancient connection between the Indians of the Chaco and the Incas themselves. Mr. Barbrooke Grubb, in his deeply interesting book, 'An Unknown People in an Unknown Land,' has pointed out certain resemblances between the culture of the Lengua Indians, among whom he lived for many years, and ancient Peru, as *e.g.* in the methods of weaving and the patterns introduced in their blankets, in their string bags, feathered head bands, and the distension of the ear-lobe; and also that some of their superstitions and traditions, *e.g.* their ideas regarding the rainbow, and cities of the dead, point to a Peruvian origin. He also says that among the Lenguas, who live directly to the east of the Auslachlay, there is a distinct trace of a superior people running in a north-westerly direction towards Peru, of fairer skin, finer features, greater intelligence, and of a more self-reliant and aggressive character. In fact, in Mr. Grubb's opinion a decided strain of Peruvian blood is traceable in the Chaco peoples.

Whilst regarding some of Mr. Grubb's views as whimsical, Baron Nordenskiöld admits that it is "not impossible that when the Spaniards conquered the Incas some Indians fled to tracts lying east of the Andes. There are a good many traditions of such an emigration. Such refugees would naturally be of great importance as bearers of culture."

The author of this book has started a most interesting line of inquiry, which it is to be hoped further exploration and study of geographical distribution will extend and amplify.

In addition to the forty-four maps showing the geographical distribution of the elements of Indian culture, there are a number of admirably clear illustrations in the text, and a full and most useful bibliography is added. The addition of an enlarged map of the Gran Chaco would have enhanced the value of the work. E. A. P.

A Winter Circuit of our Arctic Coast. A Narrative of a Journey with Dog-sleds around the entire Arctic Coast of Alaska.— **Hudson Stuck, D.D., F.R.G.S.**, Archdeacon of the Yukon and the Arctic. *Maps and Illustrations.* New York: Charles Scribner's Sons. 1920.

In the autumn of 1918 Dr. Stuck started from Fort Yukon and travelled by the Chandelar, Koyukuk and Kobuk rivers to Kotzebue Sound, where he commenced an interesting and arduous tour along the Arctic Coast of Alaska. From Kotzebue village he travelled over the coast ice past the imposing Cape Thompson to Point Hope, where he spent Christmas. Strong and biting north-east winds were frequently experienced during the journey, and they are particularly violent on this north-western coast. At Cape Lisburne furious blizzards hurl huge stones over the top of the promontory which rises about 700 feet above the water, and as one was raging when Dr. Stuck's party reached the neighbourhood, they had to follow a very difficult trail across the base of the promontory. A short distance beyond Cape Beaufort the last elevation is passed, and thereafter the coast is flat and monotonous for hundreds of miles,

as far as the eastern side of Harrison Bay. Point Barrow, the northernmost point of Alaska, is only a sandy spit. On the journey thence to Flaxman Island cold north-easterly storms were again frequent and thick haze often shut out the view. Somewhere about Anxiety Point Dr. Stuck must have passed Storkerson's party, which turned northwards from Cross Island, and at Barter Point, Stefansson's base camp, he met Captain Hadley. From Herschel Island he returned to Fort Yukon by the Firth and Colleen rivers, overtaking Stefansson on the Porcupine River. As reported in the *Journal*, the explorer had lain ill for some time at Herschel Island, and he was being taken to the hospital at Fort Yukon.

The maps of the Alaskan north coast are very defective, and many capes are marked on them which do not appear from the land side as capes at all. The charting was done from vessels at a safe distance from the coast, and in some cases hills in the background may have seemed to rise directly from the sea, the intervening low ground being invisible. However, Mr. Leffingwell resurveyed most of this coast in the years 1906–14, and his sketch-map of the coastline from Point Barrow to the boundary is reproduced in this volume. Yarborough Inlet is removed from the map, and the Romanzoff Mountains, which are sometimes omitted though clearly separated from the Franklin Mountains on the west by the Hula-Hula river, are restored.

Dr. Stuck visited the coast chiefly to inspect the missions, and therefore has naturally much to say about the Eskimo, their education, etc. He also gives some interesting information on reindeer, of which there are now at least 80,000 in Alaska; on seals and whale-fishing—once a very profitable industry, especially at Point Barrow, but now almost extinct; and on furs and the fur trade. On other subjects also, not geographical or zoological, he makes many remarks in general characterized by shrewdness and common sense, which lend variety to an interesting narrative. W. A. T.

AUSTRALASIA AND PACIFIC

White Shadows in the South Seas.— Frederick O'Brien. *Plates.* London: T. Werner Laurie, Ltd. 1919. 25*s. net.*

If years bring discretion, the maker of this book may be accounted a young man. Every serious traveller acquainted with the personality of the Marquesas islanders, and the squalid history of their intercourse with white men during the past hundred years and more, knows that on this subject silence is golden. Blasphemous oaths and coarse language put into the mouths of its characters repel the reader; and incidents in the dissolute life of low white men and native women should be abjured by a writer who in his preface disclaims, and rightly so, any qualification to speak from the platform of anthropological research. The book belongs to that unsatisfactory class in which an element of truth is overlaid and distorted by a free efflorescence of fiction, and seems designed to invest the writer's travels with an atmosphere of glamour which is far from real. It describes the Marquesas islanders with a levity and half-concealed contempt that ill befits a guest who has lived with them as boon companion and accepted their hospitality.

The volume is liberally interleaved with views and figures from photographs, some of which are not what their titles represent them to be (*vide* pp. 281, 368). Many, however, are really good. B. G. C.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Manuel de Topométrie. Opérations sur le terrain, et Calculs.— Jules Baillaud, Astronome adjoint à l'Observatoire de Paris. Paris: Dunod. 1920. Pp. 222. 13 *francs.*

M. Jules Baillaud, a captain in the French Territorial Army, embodies in this readable book his experience as a war-time surveyor and as an instructor in the French Artillery Survey School. As the title indicates, he deals with the survey of small areas, confining himself to the spheres of the trigonometrical observer and computer, and omitting all reference to topography. In his opening chapter Captain Baillaud discusses, with great lucidity, the precision desirable and obtainable by different methods. Unfortunately for English surveyors he talks of French instruments which are little known in this country, and uses the French grade in his discussions of angular measurement. Not all of us will agree with his premises. For example, he classes the order of error to be expected in a length measured with a steel tape (surface taping) as 1/5000 under the happiest conditions and as large as 1/2000 under ordinary field conditions, and estimates the error to be expected in tacheometric measurement under similar conditions at much the same figures.

The next chapter dealing with instruments, their possibilities, and adjustments is particularly lucid and valuable. Mention is made here of a type of tacheometer little known to us, the Tachéomètre Sanguet, in which the telescope is elevated or depressed to read upon different parts of the staff. The telescope, pivoted near the object glass, is set to four different angles of elevation, such that the increase of the tangent of the angle is a constant between each successive pair of pointings. For calculation the lengths on the staff corresponding to readings 1—2, 1—3, 1—4 are taken. The author prefers this instrument to the ordinary tacheometer and claims that, with the aid of Crelle's Tables or of a specially constructed graph, the subsequent calculation is simple and speedy.

In chapter vii. the author deals with intersection, and begins here to explain the graphic methods of calculation which figure largely later on. His method of showing graphically the error to be expected in a ray (or its "sensibilité") is valuable. Chapter viii. has much of interest on instrumental resection. So large a part did resection play in war-time survey that it is not surprising to find twenty-three pages devoted to this subject. He starts, naturally, with intersection from three known points. So far the subject has been dealt with amply enough in former works on surveying. He continues with a discussion on the solution of an interpolation from any number of known points. The methods of calculation advocated (and admirably explained) are semi-graphic and are familiar to most surveyors whose privilege it was to pursue their trade at the Front. They will be new to many, and are to be met with in very few other publications.

In chapter ix. the author is sound if somewhat pessimistic on the subject of traverses. He does not deal here with the use of chain or tape, but with the tacheometer. Curiously enough Captain Baillaud does not refer, directly, to the value of "bearing checks" obtained by including any one visible trig.-point in the round of angles at a traverse station.

There are numerous clear and well-figured diagrams throughout. The book will not displace any of the surveyor's old friends: it will be a useful addition to them, however, for it will help many to a clearer idea of the relative values of the various methods of plane survey, and will provide them with a valuable aid to neatness and speed in computation.

H. S. L. WINTERBOTHAM.

GENERAL

The Study of the Weather.— E. H. Chapman. Cambridge Nature Study Series. General Editor, Hugh Richardson. Cambridge: University Press. 1919. Size 8 × 5, pp. xii., 131. *Illustrations and Map.* 3*s.* 6*d. net.*

This little book hardly bears the impress of the difficult circumstances in which it must have been written while Dr. Chapman was serving as a Meteorological Officer, R.E., on the Western Front. It is meant to be a simple exposition of everyday weather against the background of the climate of the British Isles, and it serves its purpose well. The mechanical side of the subject, dealing with the construction of simple meteorological instruments such as makes most appeal to the average schoolboy, is well treated, though the official meteorologist may find fault with the directions given on page 50 for the construction of a rain-gauge.

A noteworthy feature of the work—invaluable in making boys think—are the Exercises in each chapter put in the form of questions and notes. One or two suggestions here might be helpful. The question, for example, on page 59, "Are the hottest days in summer sunny or cloudy?" admits of a very definite answer; but "are the coldest days in winter cloudy or clear?" cannot be answered so definitely as the author apparently intends it to be. Again, on page 56, "When do thunderstorms occur frequently?" "In what part of the year are they very rare?" might be rendered far more instructive climatologically if coupled with the same questions for gales. The seasonal opposition between thunderstorms which are most frequent and severe round the high solstice, especially inland, and cyclonic gales which characterize the period of the low solstice, especially at sea, is nearly perfect, and England which lies in the debatable region between the Continent and the ocean experiences both the summer and winter types of storm in a marked degree. The book is adorned with some excellent photographs of clouds and other subjects. The striking frontispiece, "A Wintry Sky and Landscape, Matlock," is climatically apt, since snow figures prominently in the winter climate of Derbyshire, a county notorious for the severity and duration of its snowstorms.

Dr. Chapman's book should inspire that wholesome love of Nature which the environment of many of the best schools throughout England is well calculated to nurture. L. C. W. B.

The "New Era" Globes.— E. M. Walters & Co., 71 and 84, Goldstone Villas, Hove. 4*s. each.*

Every attempt to give the globe a more prominent place in schools deserves encouragement. What is wanted is a globe that can be handled by the child itself, and with the commendable object of meeting this need E. M. Walters & Co., of Hove, are producing a set of seven globes in the form of hollow indiarubber balls like a child's playing-ball, with the outlines of continents, political divisions, and special physical features shown boldly by colours. Each globe measures just over 4½ inches in diameter, and the whole set, as at present arranged, will consist of seven, as follows: (1) Political Divisions and Chief Trade Routes; (2) Orographical Features; (3) Annual Rainfall and Wind Systems; (4) January Temperature at Sea-level; (5) July Temperature at Sea-level; (6) Natural Vegetation Regions and Ocean Currents; (7) Routes of Chief Explorers and Dates of Discovery. Of these, Nos. 1, 2, and 3 are now ready, and can be purchased for 4*s.* each, with cheaper rates for larger numbers.

The idea seems good, and the project deserves to succeed; but there is

room for considerable improvement in the production of the globes. The outline is too roughly drawn and in places very erroneous. Some of the explorers' routes need correcting, and one notable case is the track of the *Fram* and the position given to Nansen in 1895. The colouring is unnecessarily crude and might be improved. However, these globes are a step in the right direction, and it is hoped that the publishers will be encouraged to go on and improve in the work they have undertaken.

International Waterways.— **Paul Morgan Ogilvie, M.A.** New York: The Macmillan Company. 1920. $3.00.

This book by an American writer comprises a treatise on the freedom of the seas, and a reference manual to the treaties, laws, etc., governing the use of inland waterways. A further treatise on the latter subject is promised: thus the reference-manual, which occupies the larger half of the volume, is in fact an appendix, not to the present, but to the forthcoming treatise. Possibly President Wilson's notion that something has to be done for the freedom of the seas has prompted an immediate handling of that subject. An early chapter traces the development of the maritime law from its beginnings in the Mediterranean. The subject is well handled, though some conceptions are disclosed which provoke a word of criticism, as, for instance, "Maritime law must not be considered solely as the law of a particular country, but as part of the general law of nations"; "Clearly no nation can change the law of the sea"; and "Admiralty jurisdiction is that which a nation exercises beyond its territorial limits." The inaccuracy of these general statements can only be indicated here in equally general terms. All maritime law is, in fact, local, and no law of nations is effective that is not local law. The law of the sea is the product of changes made by local law and decisions of local courts, adopted elsewhere if approved. In later times, it is true, the new accretions are largely due to international agreement, but each nation, unless restrained by treaty, can and does alter the law for its own nationals and foreigners frequenting its ports. Nor is Admiralty jurisdiction exercised beyond the territorial limits: a court acts only when it has a *res* or a *persona* within its reach.

In some interesting chapters Mr. Ogilvie discusses the claims made by nations to the sovereignty of particular seas. Under the Bulls of Alexander VI. Spain claimed to exclude all foreigners from the Spanish Main, as did Portugal from the Indian Seas, under penalties of death, torture, and imprisonment; Venice and Genoa exacted dues from foreigners traversing the Adriatic and Ligurian seas; England demanded a salute in recognition of her sovereignty of the Four Seas. The author classes all these Powers as defenders of the *Mare Clausum*, and twits England with inconsistency in resisting the preposterous claims of Spain and Portugal. The charge is hardly just: England did not seek to close the narrow seas, and if Spain had been content with a salute there might have been no Armada. In any case, the inconsistency is hardly comparable with that of the United States, who before the cession of Alaska opposed with Great Britain the claims of Russia to sovereignty of the North Pacific, and after the cession claimed against Great Britain the same sovereignty as the successors of Russia. In this part of his book Mr. Ogilvie is not sufficiently careful of his terminology. After using the word "sovereignty" in reference to these claims over particular seas, he applies it to command of the sea in time of war, which is quite another matter. Thus at p. 96 he says that Trafalgar gave England the undisputed sovereignty of the seas, whereas at p. 106 she is said to have abandoned the sovereignty of the seas when after Trafalgar she withdrew her claim to the salute in the Channel.

A. G.

Wanderings and Memories.— **J. G. Millais,** author of 'A Breath from the Veldt,' etc. *With 4 Collotype Plates and other Illustrations from Author's Drawings and Photographs.* London: Longmans, Green & Co. 1919. *Price 16s. net.*

Mr. Millais describes his new work as "a conglomeration of anything in life that might prove of interest to men and women who move about and do things a little out of the ordinary ruck." He describes his early experiences of shooting and bird collecting in England and Scotland, a fishing tour in Iceland, salmon fishing in Scotland and Norway, hunting in Africa. Other chapters contain a notice of Arthur Neumann, the elephant hunter, with various personal anecdotes, and the author's adventures with German spies in Norway, where he narrowly escaped capture by a German U-boat. Interspersed with the narrative are notes on divers subjects, on birds, animals, and natives in Africa, fish and birds in Iceland and the Lofoden Islands, on the Icelanders and Færoese, and the relations of Norway with Germany during the war. There is therefore no monotony in the book, which will afford very pleasant reading to many others besides sportsmen.

THE MONTHLY RECORD

EUROPE

Iron Ores of Lorraine.

THE possession of the rich iron deposits of Briey and Longwy, in the portion of Lorraine which remained to France after 1871, has been recognized as one of the primary objectives of Germany in engaging in the late war, which for this reason, no less than for the enormous amount of iron consumed in the military operations, has been termed the "Iron war." But though the great development of the iron industry in the years immediately preceding the war centred about those places, thanks to their favourable situation in respect of coal supply, they are far from representing the whole of the iron-ore resources of this part of France. Under the title "Un gisement oublié: le fer sous les Côtes et la Vallée de la Meuse," M. Paul Durandin calls attention (*La Géographie*, vol. 33, No. 4, April 1920) to the very extensive deposits contained in the iron-bearing oolites (limestone with grains of oxide of iron, and ferruginous clay) which underlie the coralline limestone of the Heights of the Meuse, east of the upper valley of the river. They crop out near the base of the eastern slope of those heights, where they are easily accessible by galleries, and dip westward under the valley of the Meuse, where they can be reached at no great depth by means of shafts. Although entirely neglected by recent geological writers and not shown at all on the sheets of the geological map of France, these deposits were formerly well known and exploited, as is indicated by the place-names (Forges, and the like) which bear witness to the old iron-workings in this geological horizon. The iron-bearing outcrop was clearly shown in the geological map of Buvignier in 1845, and ten years earlier the department of the Meuse had produced more iron than the Moselle and Meurthe together. The decay of the industry, which was carried on with wood from the Meuse forests as fuel, has been due to the rapid development of the coke-furnaces of Meurthe and Moselle, as a result of which the last wood-furnace was closed down in 1882. M. Durandin considers that the far more extensive deposits of the Meuse may have a future as brilliant as those further east. He thinks it

possible that some idea of this sort may have been at the bottom of the determined but unavailing German efforts against Verdun, though these were surely explicable enough on strategical grounds only.

The Eruption of Katla in Iceland, 1918.

The volcano of Katla, situated some 50 kilometres south-west of Hekla, was in violent eruption in October 1918, after remaining quiescent since the last previous eruption in 1860. A note by M. A. Lacroix in the *Comptes Rendus* of the Paris Academy of Sciences for 12 April 1920 gives some account of the eruption from data sent to him from Iceland. A little after noon on the 12th a slight earthquake shock was followed by the uprising above the Mýrdalsjökull of an enormous column of incandescent ashes visible throughout the island for 200 to 300 kilometres. At Reykjavik a thick fall of ash darkened the whole sky, and a tidal wave was experienced on the coast south of the volcano. As is usual in Iceland, the paroxysm was accompanied by violent glacier outbursts. The first visitor to the crater after the eruption was M. Pall Sveinsson, whose notes have been placed at M. Lacroix's disposal. Katla lies in the east-south-east of the Mýrdalsjökull, one of the great ice-masses of southern Iceland, and on its south-east side extends the Mýrdalsandur, a great desert of sand formed of the material deposited during the glacial outbursts. In the north-west and south-west the Mýrdalsjökull is surmounted by two domes of ice rising to heights of 1500 to 1600 metres. Between them is a cup-shaped depression at the bottom of which the crater of Katla opens. Even the outer slopes of the ice-dome by which M. Sveinsson ascended were covered with ashes to a depth of half a metre, and those falling to the crater with half as much again. The rift of the crater, which measured from 500 to 800 by 40 metres, was free from ice, but water was flowing along it. No fumeroles nor products of sublimation were seen, only a yellowish-brown mud, the lighter portions of which seem derived by alteration from the darker, heavier ash. The glacier torrents had opened two deep ravines towards the south and east, and had done considerable damage, carrying with them huge masses of ice to a distance of 30 kilometres. The stony débris had formed a vast promontory on the coast similar to that formed in 1860. Like the thirteen previously recorded eruptions, that of 1918 was exclusively explosive, with no outpouring of lava—a fact more remarkable from the vicinity of Katla to the scene of the great fissure eruption of 1783. A chemical comparison of the ash of 1918 with the lava of 1783 will be of interest, for it is possible that the exclusively explosive character of the Katla eruptions may be due to the superimposition of the enormous ice-mass of the Mýrdals-jökull. A preliminary analysis of the ash shows it to be rich in titanium, a character common to the few examples yet analyzed of the basaltic volcanic rocks of Iceland, the Færoes, and Greenland.

ASIA

Sir Aurel Stein's Maps.

Some specimens of the new atlas of forty-seven sheets on the scale of 1/500,000 are now shown in the map-room of the Society. The new atlas embodies the topographical results of the third expedition (1913–1915), as well as those of the first and second journeys for which the maps were originally published by the Survey of India, on the scale of 4 inches to 1 mile. The drawing of the new maps began in 1916, and the last of the forty-seven sheets is now approaching completion at Dehra Dun. The maps will be included in the reports of the third expedition, now in preparation, and will also be published separately. The materials and methods of compilation will be

described in a Memoir to be published in the records of the Survey of India and reprinted for issue with the new atlas. It is expected that this will be ready next year.

AMERICA

Chlorine Content of the Waters of Nova Scotia.

Mr. H. B. Vickery gives the principal results of a determination of the normal chlorine content of the spring and brook waters of Nova Scotia in the *Transactions* of the Nova Scotian Institute of Science, vol. 14, Part 4. They show that, though salt springs exist in certain parts of the peninsula, these have probably little effect on the values obtained, whilst the influence of the sea is quite striking, as is well brought out by a map on which the "isochlors" or lines of equal chlorine content are drawn. On the coast the content is high, but it gradually decreases as one travels inland, the decrease being more rapid on the Atlantic side than it is on that of the Bay of Fundy, possibly by reason of the gypsum deposits in the Annapolis Valley region. The value of such determinations, which have been made with great thoroughness for parts of the United States, is for their use in deciding on the quality of water to be used for drinking purposes. By "normal" chlorine content is signified the content in waters not liable to pollution by sewage, etc.; and whereas water with a chlorine content of sixteen parts per million would be subject to suspicion on the score of pollution in an area where the normal content was only three such parts, it would probably be wholesome if it came from a region where the normal content was twelve. The high chlorine content in water near the sea seems in part at least due to the salt spray carried by the wind from the breakers on the coast.

AUSTRALASIA AND PACIFIC ISLANDS

Detzner's Journeys in New Guinea.

Before the outbreak of war a German officer, Captain Detzner, had started on an expedition to the region of the Waria river with the object of surveying the Anglo-German boundary in that region, which lies on the north side of the island south of Huon Gulf. The outbreak of war (tidings of which reached him somewhat dramatically in the form of a note taken from the hand of a dead native) found him in the interior, cut off from all sources of supply on the coast by reason of the Australian occupation, yet he was able to maintain himself by the aid of friendly natives during the whole period of the war and to traverse in various journeys some of the least known parts of the island, both in the peninsula north of Huon Gulf and further inland in the great range which forms the main water-parting of the island. A brief outline of the journeys and their geographical results is given in the *Zeitschrift* of the Berlin Geographical Society (1919, Nos. 7 and 8). The earliest journeys (in 1914) led inland from the Waria river to Mount Chapman (which was climbed), and followed the course of the international boundary more or less closely to beyond Mount Joseph nearly as far west as the 145th meridian. On the return the main watershed was crossed in 146° E. and a descent made on the north by the hitherto unknown upper course of the Watut, an important southern tributary of the Markham. It flows through a grass-covered upland seamed by gullies, and only emerges from its canyon in the limestone three days' journey from its mouth. The natives dwell in primitive huts cultivating the coconut palm up to a height of 4000 feet. During the course of his later wanderings Detzner traversed the whole length of the mountains—the Saruvaged and

Finisterre ranges—which fill the interior between Astrolabe bay and Huon Gulf, the former reaching a height of 4180 metres (13,700 feet), the greatest known height in any part of German New Guinea. During the ascent the traveller passed through a succession of vegetation zones, from the primeval forest with bamboos, though tree-ferns, conifers, and rhododendrons, to the grass-covered summit-plateau, mostly wreathed in mist, with an alpine flora somewhat allied to the European. Red birds of paradise frequent the lower levels, parrots, etc., the higher ones, while the grassland harbours kangaroos in considerable numbers, for the hunting of which the natives ascend to these chilly heights. The Saruvaged is a limestone massif divided into three plateaus linked together by ridges. It falls to the east in a perpendicular wall of white limestone, which has no doubt given rise to the report of snow-clad mountains in the locality. The coast was reached on one or two occasions, but attempts to evade the vigilance of the British were unavailing, and the traveller was again forced inland once more to attempt to break through overland to some other part of the coast. Detzner followed the main Bismarck range to 145° W., but his health broke down, and he retired to quarters among his native friends the Burrum, with whom he remained till the end of the war. The results of the journeys include much new information on the mountain and river systems, the geology, vegetational features, fauna and native inhabitants, the last of which are more numerous than has been supposed. Traces of glacial action were seen on the summit of the Saruvaged.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Volcanism and Glaciation.

Attention was recently drawn in the *Journal* (vol. 54, p. 63) to a new theory of Ice ages propounded by Mr. C. E. P. Brooks, attributing the former extension of glacial conditions over much of Northern Europe and North America to elevation of the land, and it was suggested that a geophysical interpretation of this character has more claim to serious consideration than many of the cosmical hypotheses, such as Croll's, which were at one time so much in vogue. In a paper entitled " Factors of Climatic Control," published in the *Journal of the Franklin Institute* for December 1919 and January 1920, Prof. W. J. Humphreys (U.S.A.) also takes up the problem on geophysical grounds, but instead of finding the chief factor in land elevation, he considers the periodic extension of glaciated areas to be due more probably to the effects of vast quantities of fine dust shot into the upper atmosphere during periods of exceptional volcanic activity. He devotes a very full physical and mathematical discussion to the question of the size and nature of the dust particles, the time they would take to settle down to the Earth's surface, and their absorbing, radiative, reflective and scattering properties for in-coming and outgoing radiation ; and shows that the effects of such dust would suffice to lower the mean temperature by an amount adequate to produce an Ice age. In confirmation of this view he exhibits diagrams indicating how in the years immediately succeeding great volcanic upheavals in our own time, such as Krakatau in 1883, Mont Pelé in 1902, and Katmai in 1912, a reduction in the mean temperature of the Earth as a whole took place. Humphreys does not consider land-elevation to be a sufficient single cause of extensive glaciation, but, though he makes no specific reference to Brooks' paper, he allows that elevation may have acted as a contributing cause of Ice ages, and points out, indeed, that mountain building and excessive volcanic activity must have been contemporaneous phenomena. He is even willing to admit that the slow

periodic variations in the eccentrictiy of the Earth's orbit and in the seasonal times of perihelion, etc., which used to be put forward as the sole explanation of glacial conditions, may also have helped as minor factors in the past history of the Earth. This is no doubt the proper perspective in which to view such problems, considering the complexity of most natural phenomena and the improbability that such complex physical conditions can be explained as the result of single causes.

GENERAL.

Geography at the Imperial War Museum.

Though the museum was in a very creditable state of order on the opening day, it is still far from complete. One may, however, already see that it is of great interest to geographers. In the section devoted to the work of a Field Survey Battalion R.E. are shown the methods of sound-ranging and flash-spotting that were still more or less confidential when Colonel Winterbotham read his two papers in the spring of 1919. The whole apparatus of a sound-ranging post is there, but at the time of writing the promised "flash and buzzer" board is not. An excellent series of editions shows the development of the large-scale tactical map, and another series the method by which it was made, with detail from air photographs. There are some pretty instruments: periscopic theodolite and plane-table alidade; and a very neat and compact prismatic theodolite which may well prove as useful in ordinary survey as it did in the observation posts. The F.S.B. section is shown in an alcove still bearing its old Crystal Palace title "English Mediæval Court," and on the walls are a rather miscellaneous lot of pictures, which we hope to see replaced by more maps and photographs of the battalion's work, such as we saw when Colonel Winterbotham read his papers to us. The maps showing the general "order of battle" on 11 November 1918 might be supplemented by the excellent sheet which showed the captures made by the British armies in the previous months, and by sheets produced by the F.S.B. in Cologne for the army of the Rhine. We shall hope to have also specimens of the work of the Survey Battalions in the more distant theatres of war.

The exhibition of war paintings at the Royal Academy last winter prepared us for the best and also for the worst. The landscapes of the more advanced artists are incredibly absurd, and do nothing to advance the knowledge of natural beauty which is to play so important a part in the geography of the future. But there are in the collections many very beautiful paintings and drawings which will have great value in descriptive geography; and we hope that when they are catalogued it may be possible to include a regional index.

The Reconstruction of Serbian Libraries.

The South Slav sub-committee of the Entente committee started by the Royal Society of Literature to foster intellectual relations with foreign countries is appealing for help for the reconstruction of Serbian libraries destroyed or dispersed during the war. It is felt that the gift of a representative library to Belgrade will be a permanent memorial of the admiration of Great Britain for Serbia, and a link in that chain of mutual understanding between nations upon which the future peace of the world largely depends. The sub-committee has now received about eleven tons of books, and Journals of this Society and hundreds of pounds worth of volumes and duplicate specimens given by the South Kensington Museum have also been sent independently. The Library is growing all the time. Last year the sub-committee hesitated to appeal for money owing to the more pressing material needs of

Serbia, but now an appeal for funds is absolutely necessary in order to supply representative books that have not been presented, and in order to pay for packing and freight expenses, which are very heavy. Contributions should be sent to Lord Charnwood, 2, Bloomsbury Square, W.C. 1, and list of books offered, to Miss Waring at the same address.

The Problem of Ptolemy's Maps.

The tireless student of Ptolemy's geography and maps, Prof. Josef Fischer, returns once more to the subject in a paper printed in the *Zeitschrift* of the Berlin Geographical Society (1919, No. 7/8) under the title "Pappus und die Ptolemäuskarten." It shows that a strong new argument for the contemporaneous production of maps and text by Ptolemy himself, which so many have been inclined to doubt, is afforded by the 'Geography' of the Armenian writer Moses of Chorene, who is supposed to have lived in the fifth century A.D. This author expressly states that he took as his authority Pappus of Alexandria (*circ.* 290 A.D.), whose *χωρογραφία οἰκουμενική* is spoken of by Suidas, though unfortunately lost; and he adds the important information that Pappus (to quote the French translation of Moses by Arsène Soukry) "a suivi le cercle ou la carte particulière de Claude Ptolemée"—that is to say, the general map of the world or the special sectional maps. Soukry seems to have been so imbued with the old idea that Ptolemy himself made no maps that he totally disregarded those that have come down to us, and compared his author's geography with Ptolemy's text only, with the result that many passages could with difficulty be explained as derived from the Alexandrine geographer. Prof. Fischer has recourse to the maps, as represented not only by the printed versions of the Renaissance but by the earlier Greek and Latin MS. versions of which he has made so careful a study. He examines passage after passage of the text of Moses of Chorene, and finds that though many of the statements could by no means have been derived from Ptolemy's text, nearly all are perfectly intelligible if we suppose that Pappus had before him, as stated by Moses, either the general or special maps which have come down to us in association with the early Ptolemaic MSS. Such instances occur both in the general account of the habitable world and in the descriptions of the several countries. The description of the course of the torrid zone from east to west has no exact counterpart in Ptolemy's text, but it is just that which could be derived from the World-map, and the same holds of the accounts of the extension of the ocean and interior seas, and the division of the land between the three continents. Again, the arrangement of the detailed description of countries is quite different from that followed by Ptolemy in his text, or even from that supplied by the series of special maps, but is evidently arrived at independently on the basis of the general map; it begins, not with Ireland, but with Spain, on the ground that this is the westernmost extremity of the inhabited land, and ends, not with Taprobana, but with China and the *terra incognita* at the eastern extremity. Some items are, it is true, taken from Ptolemy's text, which must therefore have been used by Pappus together with the maps. Prof. Fischer thinks that the general map followed was the revised version of Agathadæmon which has come down to us, and not the lost original. If this be true Agathadæmon's version was in use before the end of the third century, or not much over a century after Ptolemy wrote his Geography. Here and there we find traces of non-Ptolemaic material incorporated by Pappus, or corrections introduced by him; the most striking of the latter is the reduction of the length of the Mediterranean to 30 degrees, or less than half Ptolemy's figure.

Prof. Fischer hopes later to enter more fully into the important question of the influence on his successors exercised by the work of Pappus, which was very probably accompanied by revised Ptolemaic maps.

OBITUARY

Dr. George Ernest Morrison.

WE regret to have to chronicle the death of Dr. George Ernest Morrison. The son of Dr. George Morrison, Principal of Geelong College, Victoria, Australia, he was born there 4 February 1862. From tuition under his father he passed to the Melbourne University with the intention of adopting a medical career, but the attractions of a roving life proved irresistible. In 1882, when the Kanaka labour question was attracting attention, he shipped as an ordinary seaman from Port Mackay to the South Sea Islands, in order to study for himself the conditions under which the labourers were recruited from those Islands for the Queensland plantations. His articles on the subject in the Melbourne *Age* created some ill-feeling towards himself, but effected much good. At the end of that year he made his famous tramp of 2043 miles from the Gulf of Carpentaria to Melbourne, alone and unarmed, and camping in the open when away from human habitations. In 1883 he captained an exploring expedition to New Guinea, where he was seriously wounded by the natives. His wounds gave him so much trouble that he eventually went to Edinburgh to be treated. There Prof. J. Chiene located two spear-heads still in his thigh, and extracted them. While convalescing Morrison continued his medical studies, and in 1887 took his degree as M.D. and C.M.

Three years were spent in journeys to the United States, Spain, and Morocco. Then, after studying under Dr. Charcot in Paris, he went to Ballarat and was for three years in charge of the hospital there. In 1893 he went to the Far East, and in January 1894 started on a journey from Shanghai to Rangoon. Clad in Chinese costume but speaking no word of the language, and accompanied by a few porters who spoke no word of English, he accomplished this journey of 3000 miles, half by land and half by water, with the result that though he entered on it "possessed with the strong racial antipathy common to my countrymen," he ended it with a feeling of "lively sympathy and gratitude to the natives who had treated me with uniform kindness and hospitality and the most charming courtesy."

The published account of this journey, 'An Australian in China,' dedicated to Dr. J. Chiène, "who gave me back the means of locomotion," led to his being offered by the *Times* a position as Special Correspondent in Siam, where there was then a clash of French and British interests. This being ended by the agreement of January 1896, he devoted twelve months to exploration in the interior, particularly of the Mekong valley, his articles attracting considerable attention. In February 1897 he was transferred to Peking. His opportunity came with the seizure of Kiaochow by the Germans in November, of Port Arthur and Talien-wan by the Russians in the following spring, and their consequences. He at once established a world-wide reputation by the strict accuracy and the early date of the news he sent; so uncannily early and accurate were his telegrams that they were characterized by one member of the House of Commons as "the intelligent anticipation of events before they occurred." He was in Peking during the siege of the Legations in 1900. On June 14 he headed a rescue party to the ruins of the southern

cathedral and saved the lives of a large number of native Christians. On July 16, while accompanying Colonel Shiba (Japanese) and Captain Strouts (British) in an inspection of the grounds of the palace of Prince Su, Colonel Shiba was mortally wounded and Morrison received a bullet in the thigh. In recording this incident, the Rev. A. H. Smith ('China in Convulsion,' 1, p. 345), says: "Although not a military man, Dr. M. had proved himself one of the most important members of the garrison, being always in motion and cognizant of what was going on everywhere, being by far the best-informed person within the Legation quadrangle. To this must be added a cool judgment, total disregard of danger, and a perpetual sense of responsibility to help every one to do his best." In 1905 he was present at the triumphal entry of the Japanese into Port Arthur, and attended the Russo-Japanese Peace Conference at Portsmouth, U.S.A. In 1907 he made a journey from Peking to Tonquin, and in 1910 rode from Honan city to Andijan in Russian Turkestan, a distance of 3750 miles in 175 days.

In 1912 Morrison resigned his position on the staff of the *Times* to become political adviser to Yuan-Shih-k'ai, president of the newly established Chinese Republic. Of his work in that capacity little naturally is known to outsiders; but the Chinese are not good at asking for advice, or at acting on it when given.

Last year, when assisting the Chinese delegation to the Paris Peace Conference, he was attacked by some mysterious disease, which reduced him to a shadow of his former powerful self. After several months of treatment he appeared to be recuperating and had taken his passage back to China; but his illness took a sudden turn for the worse, and he passed away in a nursing home at Sidmouth on May 30, leaving a widow and three sons.

Morrison kept a minute and carefully compiled diary, the publication of which would throw many valuable and interesting side-lights on events in the Far East during the last quarter of a century.

A. E. HIPPISLEY.

James Cosmo Dobrée Melvill.

WE learn with regret of the death of Mr. J. C. D. Melvill, a Fellow of the Society, which he joined in 1912. He was the elder son of Mr. and Mrs. J. Cosmo Melvill, of Meole Brace Hall, near Shrewsbury, and was born in 1877. After completing his education he spent a few years as partner on a large ranch in Colorado, and there acquired a taste for natural history and big-game shooting, which he gratified during many expeditions in Newfoundland, Northern Canada, Alaska, and elsewhere. Having settled at Edmonton, Alberta, he undertook expeditions, first to the Peace river district, afterwards, with Mr. J. Hornby (1909–11), to the Great Bear and Slave lakes, the Coppermine, and beyond the Arctic Circle, where he studied (almost simultaneously with Mr. Stefansson) some of the tribes of blonde Eskimos of the extreme north. Before the war he had completed, for the Canadian Government, an exploration and report on the little-known rivers entering the James and Hudson's bays from Labrador (see *Journal*, vol. 47, p. 146). Offering his services to the Admiralty, he became Lieut. R.N.V.R.; and commanded a motor launch in the West Indian region, ascending the Orinoco on one occasion for several hundred miles. He was about to organize an expedition to the Mackenzie basin under Government auspices, when he succumbed in January last to a sudden attack of double pneumonia. He was an excellent organizer, courageous, and good at handling men, and his early death is deeply felt by many friends.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1919–1920

THE ANNIVERSARY DINNER

THE Anniversary Dinner was held at the Connaught Rooms on Tuesday, 1 June 1920, with the President, Lieut.-Colonel Sir Francis Younghusband, in the chair.

After the loyal toasts had been honoured the PRESIDENT proposed "The Imperial Forces," coupling the toast with the names of Admiral of the Fleet Lord Jellicoe and of General Lord Byng of Vimy.

Admiral of the Fleet Lord JELLICOE, in responding for the Navy, said: I thank you on behalf of the Service which I have the honour to represent for the welcome which you have given to the toast. I take it as a sign of your recognition of the service rendered by the splendid officers and men of the Royal Navy, of the Royal Naval Air Service when it existed, and the Mercantile Marine, who so nobly did their duty to the Empire during the war. Many thousands of those splendid officers and men of the Royal Navy were under my command in the early years of the war, and I can assure you that you can never give them too much honour. Nor can you pay too much honour to the officers and men of our Mercantile Marine. During my service at the Admiralty I was very closely associated with their work, and I can only call it magnificent. I feel myself that I have some connection with the Royal Geographical Society, because during my tour last year I learned quite a lot of geography. But my object really to-night is to pay a tribute of grateful thanks on behalf of the Royal Navy to the Royal Geographical Society for the great assistance which they gave to the Admiralty during the war. In June 1915 Dr. Dickson with his associates started work at the House of the Royal Geographical Society in collaboration with the Intelligence Department at the Admiralty, and that work fulfilled a want, a need which was apparent not only during the war, but perhaps even more so during the Peace Conference. The work included the preparation of a great deal of information which was not only of great use to Staff officers in planning operations, but was also most useful to those whose business it came to be during the war to administer captured territory. Opportunities occurred during the war which do not occur during peace of obtaining from private firms information which they would not divulge in peace for fear of it coming to the knowledge of their trade rivals, and that information was given to the Admiralty, of course, on the understanding that it should not be given to their rivals; consequently a good deal of it which has been put into book form has to remain confidential. Nevertheless, I am told that some fifty volumes are to be placed at the disposal of the public, and as a mark of the Admiralty appreciation of the work of the Royal Geographical Society, the Board have made a present of those fifty volumes to the Society. I said that the work was of great value also to the Peace Conference. I was not on the Peace Conference myself, but I am told that no Peace was ever signed, and no Peace was ever deliberated, with a greater knowledge of the geographical conditions of the countries whose future was being decided. It was for that reason that when the Armistice was signed a special request was made that the work of Dr. Dickson and his associates should be carried on, and that section of the Naval Intelligence Department was not demobilized until July of last year; I imagine that the statesmen whose business it was to settle the Peace are at least as grateful to the Royal Geographical Society as is the Board of Admiralty.

In the presence of so many scientific gentlemen, I cannot fail to mention the other scientific work which assisted the Admiralty so greatly during the war, a great deal of which has now been turned to peaceful purposes, principally in the direction of aids to navigation. Most of the devices of which I speak were produced for the ultimate destruction of German submarines, and of those which have been "converted to peaceful use," in the same manner that swords are converted into ploughshares, are first of all what was known as the "leader gear," which has been taken up for pilotage purposes. The second was what was known as the "sonic echo gear," which is being developed and will be of great use in the future for prevention of collision at sea. The third is the echo system which is being made use of for sounding. The fourth and fifth are the two devices which are being made use of for the fixing of the position of ships at sea—one the system known as directional wireless telegraphy, and another the system of sound ranging which the Navy took up. Both these methods will be of great use to navigators in the future, and therefore we have to thank the Royal Geographical Society and other scientific bodies, not only for their work during the war, but for that work which will bring additional safety to ships at sea. Once more, ladies and gentlemen, I thank you for your kind reception of the toast.

General Lord BYNG OF VIMY, in replying for the Army, said: I must thank you for the way you have drunk the health of the Army, and I must say you have imposed the most difficult task you possibly can on any one having to reply. To begin with, first of all the Army belonged and belongs to you. The Army was exactly what you made it, because you all, my lords, ladies, and gentlemen, helped the Army. Every one of you during the war did something to make the Army efficient. Consequently in asking me to reply for something that really belongs to you, and for something you helped by every possible means in your power, you are enforcing on me a thing of extreme difficulty. The second point is (and the difficulty is even greater), that the toast of the Army has been replied to about five times a night since the Armistice, and I really think that nearly everything has been said. I certainly have nothing new to add to what has already passed. Not only have there been speeches to reply to, but we have suffered in other ways: no less than seven distinguished generals have written their memoirs, and I really think, ladies and gentlemen, that to talk about the Army now is only to be extremely repetitious. As regards the Royal Geographical Society, we do and we feel we owe them a great debt of gratitude. The mapping was extremely good. Only one case do I remember where criticism might be thrown, not on the Geographical Society but on ourselves, which was on the unfortunate occasion when I had to give evidence on the Gallipoli Commission. I went in and found an enormously large map stretched across the room. It took one's eye at once, but the President said, "For goodness sake do not look at that, it will confuse you." Otherwise I think our mapping was really wonderful. One more point: a certain amount of unrest exists and possibly will go on existing, though I honestly believe it is immeasurably better at the present moment. There is a certain feeling about this extraordinary word "democracy." I hear it every day with those people I deal with, and I cannot help thinking that if we ever do have an ideal democracy it will be that democracy that went to France, to Palestine, to Mesopotamia, and to Salonika. I am not an idealist at all, but I do think that if these extreme writers would try and visualize what the feeling was that existed amongst the men of all ranks, all Dominions, all stations, and every class of life, and how that democracy worked together, they would visualize something that goes as

near perfection as possible. I have only to thank you, ladies and gentlemen, from the very bottom of my heart for the way you have drunk the health of the Army.

Dr. D. G. HOGARTH, proposing the toast of "The Medallists," said: The duty which you, sir, have laid upon me to-night is really equivalent to asking you, ladies and gentlemen, to recognize and to applaud the progress which has been made, not only in this last year, but during all the years of the war, in that science for which this Society lives and moves; and to wish it all possible continuance of progress in the future—a wish which inspires a pledge on the part of all of us to further that progress. It can be promoted equally in the study and in the field, and the man who does most for geography is the man who best combines the two. The three distinguished pioneers and men of science with whose names I am asked to couple this toast are all of them fine examples of that best type of geographer, who has applied what he has learned in the field to his work in the study, and his work in the study to what he sees afterwards in the field. It is not the custom, I believe, on this occasion, and it might be tedious, to go into the details of the achievements of the Medallists; so I will say only a very few words about each, and I will begin, with your permission, with Dr. Jovan Cvijić of Belgrade, because he is the only man not a Briton whom we are honouring to-night. He is, unfortunately, not present. He was not able to leave his duties in Belgrade, but the distinguished Minister of his country will respond for him. In Prof. Cvijić we recognize the profoundest and at the same time the sanest of the Balkanic geographers who have applied themselves to the fascinating but perilous problems of Balkan geography. In the course of a long series of researches, going back to the nineties or earlier, Prof. Cvijić has studied the peninsula, to which he himself belongs, from almost every point of view, and has made his own almost every branch of geography. I used the word "perilous" just now advisedly; for all investigation, and particularly geographical investigation, must be perilous in a land like the Balkan peninsula where nations are always in the making, and where racial passions run red-hot; where, not so long ago, the unfortunate peasant, in the course of a single week, might be offered the choice of three separate martyrdoms on behalf of three separate nationalities, and the certain reversion of two out of three possible hells. I think it is true to say of Dr. Cvijić that he has never forgotten what he owes to scientific truth, while at the same time he has always remembered that he is a Serbian patriot; and those of us who have had to study the ethnology of that country, who had to wallow in that morass of facts that were not facts, of facts invented in order to bring other facts into existence, have often struggled out, with a sigh of relief, on to the dry land of Cvijić's statements. In his present Olympian position as Rector of his University of Belgrade I make no doubt he has the same candid spirit of inquiry and keeps the same calm judgment. I ought to say that his name was not brought forward for a medal this year because he represents a martyred Ally; but we are glad that his scientific eminence puts us in a position to-night to express our sympathy towards the Minister of the most heroic and the most sorely tried of all our Allies.

Mr. Philby takes our thoughts away to a land of violence still more ancient even than that of the Balkans. There was no land five years ago on the habitable globe (I exclude the Poles) which was darker than Arabia, and there is no land upon which more light has been shed since, and thanks, in the largest measure, to Mr. Philby. I could tell you a good many things about Mr. Philby if I liked—things about his political activities; things about his

great friend, that black-beared Assyrian King who manages to bring Nejd so frequently into the limelight. Mr. Philby is delivered into my hands at this moment; but I do not forget that, in a very few minutes, I shall be delivered into his! Therefore, I content myself with merely reminding you that no other European than Mr. Philby is known to have penetrated the southernmost districts of Central Arabia; and that in his great feat of crossing its heart he has only two predecessors, one more than a hundred years ago, Captain Sadlier, and the other in the year just before the war, Captain Shakespear. You will note that the three persons to whose credit that great achievement stands are all British officers. No European but a British officer is known to have crossed the heart of Arabia. Still further, it is a curious fact, if I mistake not, that they are all Englishmen. A little more than a hundred years ago the Governor of the Holy City of Medina was a Scot; but the Scot who shall cross the heart of Arabia is yet to appear. In rendering all the honour we can to Mr. Philby to-night, we wish also to think of that long series of pioneers which our different Services in India have sent, so admirably prepared and generally so inefficiently equipped, to explore the waste places of Asia.

The Victoria Medal is not given every year, and I think probably it would not have been given this year if we had not had to our hand so pre-eminent and so convincing a representative of the higher science applied to national defence, as Colonel Winterbotham. I am assured—and one wants that assurance, for these things have not been yet fully revealed to the wise and prudent, however much to those who are neither—that those new methods and means which in the end made our artillery survey the best in the world owe more to Colonel Winterbotham's initiative, enthusiasm, and ability than to those of any other single man. We know there were many others who took part in the development of those inventions, but we know we are right in taking Colonel Winterbotham to stand sponsor for all the application of the higher science to our offensive and defensive action in the war. In connection with that may I utter one prayer, with, I am sure, the assent of every one of you, and that is this: that the mobilization of the scientific strength of this country, which came about gradually under the stress of a great need, should not suffer too complete a demobilization now that the stress seems to be past; and that we should not re-enact that divorce, that most unfortunate divorce, of unofficial from official science. Lest we forget that the war went near to being lost in one year; that it might have been won in three or even two years, but that it went on well into its fifth year! Lest we forget with what pains and difficulty we had to discover and collect from the four winds of heaven that scientific strength of our nation, and during 1915 to marshal it, how slowly and with what difficulty, into the beginnings—only the beginnings—of an effective force, behind—(let me borrow from Mr. Kipling)—behind an ever-growing breastwork of the dead flower of our youth! It is not for me to detain you to-night. I am only fulfilling the function of a call-boy who brings to the stage the chief actors of the evening—the three gentlemen with whose names this toast is coupled. We have, some of us, been in a position not unlike theirs, and we know with what anxiety, with what impatience, they await their turn to appear before you. And if they seem modest, deprecatory of your enthusiasm and appreciation, do not allow yourselves to be too much influenced by any mistaken sentiment of compassion. The late Mr. Henry James once covered his confusion at hearing his own praise by saying, as he clapped his adorer on the back, "That's right, that's all right, my boy! We authors—we authors, you know, we can't have too much of it!" And indeed, upon my word, I do not think you

could return too much for the achievements of these three gentlemen in the field of geography, still less for all those achievements of geographers for which they have to stand sponsors to-night. You have heard from Lord Jellicoe some indication of what these were, and it is not only those for which Colonel Winterbotham has to answer, but it is all that geography did in the vast network of Intelligence service which played so conspicuous a part for us in winning us the war. Therefore, in sure and certain hope that you will receive it well, I give you the toast of "The Medallists of 1920."

M. GAVRILOVIĆ (Minister of the Kingdom of the Serbs, Croats, and Slovenes), speaking in French and replying for Prof. Cvijić, said: The absence of my eminent compatriot, M. Cvijić, has gained me the honour of being in this great company, in the company of great savants and great explorers. This improvisation of my person here is not of a nature to be made easier by the honour that the President has kindly accorded me by inviting me to speak. That is why you will excuse me, I hope, for not being able to make a speech worthy of you. I will be content with a few simple words, but which will have merit of being true echo of my thoughts. I have been very glad to receive the Medal which my compatriot has so well merited. This honourable distinction for Mr. Cvijić has for me an entirely special meaning. In effect it is the first manifestation of the scientific solidarity between our savants and a learned Society of Great Britain.

Must it be said that up till now there have been no men in our country worthy of attracting the attention of the British learned world? Most certainly that is not the case. The Serbs, Croats, and Slovenes have given men who have figured honourably as members of the Academies and of the Societies of a well-established scientific reputation, but the recognition of their merits seldom passed beyond Austria and Germany. The works of my compatriots on the history and the geography of the Balkins, when they had any interest for Western Europe, have always been printed in German. It would take rather a long time to explain the reason of this phenomenon. It is sufficient to remark that during the war a reaction began in France against this state of things, against this monopoly of German language. Conferences have been organized, chairs and an institute have been founded, with the aim of emancipating from the German influence the Slav studies in general and the Yugo-Slav studies in particular. The result is already satisfactory. I hope the same reaction will be produced in Great Britain. That is why in the Medal awarded to Mr. Cvijić I do not see a simple honorary distinction for one of my compatriots: I see there the interest of the scientific world of Great Britain in my country, which up to the war was considered, from the point of view of intellectual work just as from the economic point of view, as making part of German land. I rejoice particularly in this manifestation, and it is in this spirit that I have the honour to thank the Royal Geographical Society, making very sincere wishes for its prosperity.

Mr. H. St. J. B. PHILBY: It is not so much my fault as my good fortune that I am here to-night to address you, and I may say I am profoundly thankful to the President for the condition of brevity he has imposed on all those taking part in the proceedings; in any case the excellent speech we have heard just now, in the most charming of all languages, has relieved me of any necessity of speaking at great length; all I have to say, therefore, is a few words in reply to the very generous terms in which Dr. Hogarth has referred to me this evening. As to the Gold Medals of this Society, Dr. Hogarth has explained one of the objects for which they are given, to record the progress in our

search for the object for which this Society exists; but there is also a rather more pathetic side to these Medals. It seems to me that as year after year the Royal Geographical Society awards its medals, it buries, as it were, a mystery which till then was alive. It places, as it were, a milestone on the path of progress towards a known and completely dull world. Yesterday those of you who were present at the Anniversary Meeting heard from the lips of our President the alternative which will be open to Fellows of this Society and others, when the world shall reach that goal. They will then go forth and re-search, as artists and painters, the scenes which they surveyed before as explorers. When I heard that Address yesterday, much as I agreed with it, I wondered whether it would be possible to practise the doctrine preached by the President in the country with which I am connected. I do not believe there is anything of beauty in all Arabia. Nevertheless I have no desire but to go back to that country, and I promise the President that, if I go, I shall search for beauty where I have hitherto failed to find it. Dr. Hogarth has an extraordinary faculty of praising people to their faces without offending, and all I can do is to attempt to imitate him. Dr. Hogarth is himself quite a recent Gold Medallist of the Society—I think in the last year but one—and I believe I am right in saying his Gold Medal was granted him also in part for services in connection with Arabia. He and I, therefore, share that distinction, and we share it with two people who are unfortunately not present to-night—the great Charles Doughty, the greatest of all who ever travelled in Arabia, and the greatest of all travellers, the greatest because she is a woman, Gertrude Bell. I have only two more things to say. When it was sprung upon me that I had to make a speech I thought that I would propound a problem for the consideration of the Council of the Society. Recently, exploration by air has become the fashion, and one great Continent—the Continent not very long ago completely dark—has been traversed from north to south by air. Now the peninsula of Arabia, 1500 miles or so, has never been traversed from north to south either by air or in any other way in all the ages. What I propose is that if anybody will put down a reasonable prize to race an aeroplane across the continent of Arabia, I will myself compete by camel. The fact that this Medal has been granted to me seems to me a complete vindication of the objects for which the Society exists. Until a year or two ago I had no claim whatever to be a geographer, explorer, or scientist of any kind. I was pitchforked, more or less by accident, into Arabia, where I used the senses with which Nature has endowed me, eyes, ears, and other limbs; and to my intense surprise when I came home I was accorded a reception such as I have never been accorded in all my life before, and have been awarded the Medal of this Society—a fact which surely proves that such an honour is within the reach of any one who goes out to an unknown country and there use his faculties.

Colonel H. S. L. WINTERBOTHAM: I feel sure that no one who is honoured by one of the much-prized distinctions of the Royal Geographical Society can fail to experience a large measure of humility. There are two circumstances which do tend to mitigate that feeling to-night. One is that nobody who served in the Third Army can feel that he is friendless in the presence of Lord Byng of Vimy. The second is that the President, in his Address yesterday, laid it down as one of the more important duties of the geographer to watch with a critical eye the effect of the works of man upon the beauties of the landscape. Now I venture to assert that no body of surveyors has ever watched that effect with a more critical, and even more anxious eye, than the topographers on the Western Front. It was at times slightly nervous work, but always interesting.

The particular terms in which the Royal Geographical Society has done me this singular honour are connected partly with artillery intelligence and partly with mapping of inaccessible areas. The question of artillery intelligence is one which we started. Once started, and the lines upon which we wished to develop laid down, progress was assured by that band of brilliant, devoted young scientists who were gathered together to join the ranks of the Field Survey Battalions. It was perfectly safe in their hands. As regards the mapping, we started well ahead of friend and enemy, for we had in the non-commissioned officers and men of the Survey Companies an asset absolutely unique. These soldiers work in peace upon the same tasks which confront them in war. They are trained at home and in the Colonies on exactly the subjects that met them on the Western Front, or in Mesopotamia, or in Egypt; so that the work which was left for Colonel Jack, our chief, and for the rest of us was only to sit more or less quiet and watch these exceedingly intelligent and devoted people working out our salvation, and incidentally making for somebody else's reputation. There are two factors without which it would have been impossible to have done anything. The first is the concurrence and help of the Army Commands and of the General Staff. It is very curious to watch the quarrels now going on in the German scientific papers, in which it is quite evident that the geographer was accused by the General Staff of being ultra-scientific, and the General Staff accused by the geographer of being narrow-minded and selfish. In the British service, though no doubt we were often stupid, and often too anxious in our demands, we met with sympathy and help. The second factor is that most of our work was directed to the aid of our friends and brothers the gunners. Throughout our attempts at help we received encouragement, and an invaluable atmosphere of mutual co-operation from them. There was very little to do then, for the General Staff fed us, the climate of Flanders supplied water in abundant quantity, the Germans saw to the ventilation of our temporary quarters, and we Commanding Officers had a very pleasant and interesting time. There remains nothing for me but to express once more my deep appreciation of the singular honour which the Society has done me.

Sir MAURICE DE BUNSEN, in proposing the toast of "The Guests," said: I have a very agreeable task this evening, and a great part of it has already been done for me by the speeches which you have heard and which have brought before you the great names of Lord Jellicoe and Lord Byng and our several other very distinguished visitors, the Minister of the Serbs, Croats, and Slovenes, and the Medallists. I would not, therefore, refer to any of these any more, but there are some others amongst the guests of the Society and our private guests whom I should like to mention. And I would begin by saying that I am sure we of the Royal Geographical Society are extremely gratified to see amongst us this evening a number of ladies. The presence of ladies on an occasion of this kind adds charm and colour and grace and other delightful attributes to a gathering of this kind, which in ordinary circumstances is sometimes—not always, but sometimes—towards the end of a long evening a little drab in complexion, and monotonous in tone. Certainly that would not apply to our gathering this evening. It has been a pleasure to see so many ladies, and I have no doubt that next year there will be many more, but the number to-night compares very favourably in proportion to the House of Commons, so we ought to be satisfied with having got so far as we have this year. Now I come to one or two names of the profession to which I have belonged for a great number of years. Diplomacy, perhaps, is not exactly popular at this

moment in the public eye. It has met with a good deal of rather severe criticism. I am not without hopes myself that the future historian, that much to be pitied author of somewhere or other, will discover that if you judge our diplomatic representatives by the results of their action they did not come out so badly at all, because, taking the whole range of countries in which they worked day and night throughout the war, one after another, they either joined us or came a long way to joining us by dismissing the German Ministers, or even if they had not the courage to join us, the masses of their people were with us, and I hope the future historian will discover that part of the Diplomatists' work. Of course, it was all largely owing to the justice of our cause, but much of it was also owing to the personality and patriotism and perseverance and hard work of our Ministers abroad. This evening we are very glad to welcome Sir John Jordan, who has, I am afraid, brought to a conclusion a very distinguished career which entitles him certainly to be bracketed with the great names of Sir Thomas Wade and Sir Harry Parkes. I do not know what more could be said in a few words than that. I remember years ago, the only time I had the opportunity of being in Peking for a short time, being taken by Sir John Jordan to see a great Chinese Confucian Temple, and after riding many miles or driving over rough roads when we got to the gates of this temple there was a crowd which refused to let us in, but by dint of great volubility on the part of Sir John in their own tongue we at last made our way into the temple, and since that year, year after year, we have heard of Sir John Jordan's authority and growing prestige in China; so I repeat he has been one of our great Ministers in that country, and I am sure he is extremely welcome here this evening. Another old colleague whom we are also glad to welcome is Sir Walter Townley. During part of the year he was Minister at the Hague, and although he did not succeed in bringing the Dutch into the war our side, it may be said that by his labours and hard work, and by the attractiveness of his own personality, he at all events prevented our enemies from scoring off us, and kept the Dutch as straight as it was possible for them to be throughout the war. I may say he has surveyed the world from China to Peru, or, at all events, Buenos Aires, and therefore has collected a great deal of geographical knowledge, which I hope some day he will give us an opportunity of hearing in a public lecture. Now there are others to whom I must refer briefly. It is a pleasure to see here several gentlemen from our ancient Ally Portugal. The Portuguese Geographical Society is a very important body and a highly competent body of geographers, whose name and propensities everybody who has been in Portugal knows very well. They are a very great Society, and they have deputed to represent them here this evening Sr. Dos Passos Freitas, and I here, on behalf of the Society, bid him and his friends a hearty welcome. The Royal Geographical Society appreciates very much the compliment of being remembered by the sister Society in Lisbon on this occasion. I next come to other gentlemen who are here as our guests and who represent perhaps in a particular way literature and the arts. We have here Sir Henry Newbolt. His tales and songs of the war and the sea and many other subjects are familiar to all of us and are an inheritance that will be handed down to our children. He has inspired us all by his happy writings. He is doing a great work now in the handbooks he is producing from which the rising generation, our boys at school, can learn a great deal more about geography and its value in the curriculum of their study than any of us had the opportunity of doing when we were boys. He is a very welcome guest. Our President has already mentioned Mr. Hughes-Stanton, whose charming landscapes all of us surely know. They are

well known in many galleries all over England, also in France almost as well as in our Royal Academy, in Australia, South America, Rome, Florence, Spain, in fact all over the world, and he, as the President has already observed, is a disciple and exponent of the charming theory which our President expounded to us yesterday so persuasively, if persuasiveness be needed in such a topic, that the science of Geography is closely akin to the love of beauty in Nature. Now I have kept for the last one of the most distinguished of our guests this evening, Lord Meston, who is the beau ideal of a great Indian administrator. He has filled the high post in our great dependency of Lieut.-Governor of the Central Provinces and had a most successful period of administration there, keeping the country quiet, and leaving a great name behind him. He has been Financial member of the Council of the Governor-General, and I recollect very well his being over here during the war as one of the representatives of India in our Imperial War Cabinet and the Imperial War Conference, so that in concluding my remarks I venture to ask that Lord Meston will allow his name to be coupled with that of our guests this evening, and will respond to this toast which I now propose to you, which I feel certain will be heartily received. I drink to the health of "Our Guests" this evening.

Lord MESTON: Some one has discreetly veiled the clock; but that does not conceal the fact that the hour is very late, and it would be unseemly for me to attempt to do more than convey in a very few words, on behalf of myself and those fellow-guests who allow me to speak for them, a sense of the very high honour that the Royal Geographical Society has paid us to-night by their hospitality, and of the great honour which has been conferred upon us by the eloquent words of the eminent diplomatist who has proposed the toast. There are, I know well, among my fellow-guests several—more particularly that great pro-Consul Sir John Jordan—whom I most earnestly wish you had called upon to respond instead of me; there are several who have every right by their contributions to the knowledge of the world and its untrodden ways to stand under the banner of the Royal Geographical Society to-night. There are others who, like myself, feel that they are here somewhat under false pretences, for rather like the majority of men my lot has been to read maps rather than to make them, and to study in comfort and by proxy the fascinating tales of adventure, research, and exploration which are the special charge of you, Sir, and your colleagues in this Society. But that does not make our gratitude for what you have showered upon us to-night any the less. In the opportunity which you give us of saying what we think of you, we laymen have another cause for gratitude in being your guests to-night, and here I should like to supplement in my humble way as a civil ex-Administrator what has fallen from the distinguished and gallant heads of the fighting services here to-night. I should like to express on behalf of the layman, whether he stays at home, or whether he has the good fortune to wander on the outskirts of Empire and see the results of the work which has been done by such men as the present President of this Society, our particular pride in your work. We realize that the work of the Royal Geographical Society, its ambitions, its achievements, are anchored in qualities which lie deep at the roots of the British character and are largely responsible for the success of the British race. Those qualities are love of adventure, endurance, and the constant study and steady pursuit of accurate knowledge, however difficult of attainment. Those qualities have been placed under the severest test during the recent years of strain and stress, and we have thus had a very special proof of the indirect as well as the direct value of the work of your Society to the world. I should like, therefore, in the name of the civilian

guests here to add our tribute to that which has been paid by Admiral Lord Jellicoe and General Lord Byng to the value of your work; and we thank you once more for your generous hospitality.

Sir JOHN JORDAN, in proposing the toast of the President, said: One of your President's first essays in travel was made some thirty-five years ago in Manchuria. On his return from that then almost trackless waste, Captain Younghusband spent some months in the Peking Legation preparing for his great journey to India. His description of the descent of the Mustagh Pass is a thrilling account of high adventure and a characteristically generous tribute to the daring of his native companions. His leadership of the Tibet expedition was of great interest to us in China. Neither Bogle nor Turner had succeeded in reaching Lhasa, an honour reserved for a man from China, the eccentric Manning, who after nine years' preparation in Canton, contrived, by the aid of cherry brandy, lavender water, and an impressive beard, to explore the forbidden city. Nearly one hundred years later the success of Sir Francis Younghusband's mission excited some natural jealousy in China among those who had been trying for years to penetrate Tibet for the East. The Dalai Lama did not remain to welcome the expedition, but his wanderings eventually brought him to Peking, where he became an interesting figure in legation circles. Sir Francis saw Lhasa, and we made the acquaintance of the Dalai Lama. This Society, which numbers so many great men among its Presidents, is fortunate in having to preside over its deliberations a bold and intrepid traveller, a political thinker, and high authority on Eastern questions. I have very great pleasure in proposing the health of the President.

The PRESIDENT thanked the company for the way in which they had honoured the toast.

Fifteenth Evening Meeting, 7 June 1920.—The President in the Chair.

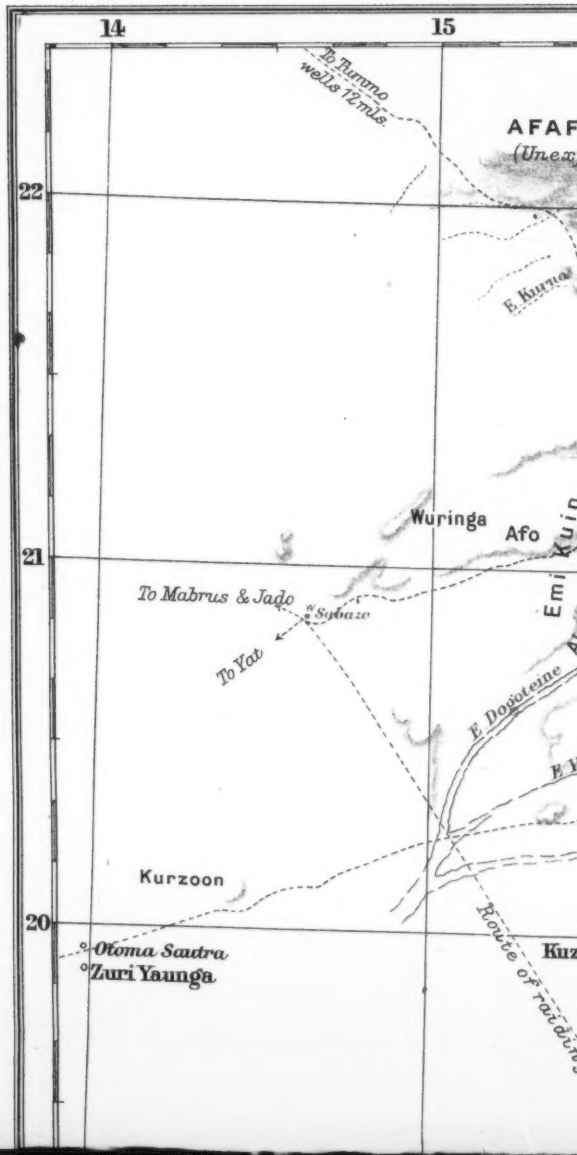
ELECTIONS.—George Beveridge, B.A.; Major J. N. Biggs-Davison, R.G.A.; Dr. Hagop Boghoss Boghossian; Captain C. W. Brown, M.C.; The Hon. Sir Harcourt Butler, K.C.S.I., C.I.E.; Oscar Henry Cocks; Colonel Henry Walter George Cole, C.S.I., O.B.E., I.A.; Miss Edith Cross; Clarence H. Davies; Hugh Carnegy Davies, LL.B.; Herbert Alfred Deed; Major Glen. E. Edgerton (U.S. Army); Colonel Campbell Blackshear Hodges (U.S. Army); Rev. Basil Dennis Jones, O.B.E., M.A.; Ronald Campbell Kemp; Lieut.-Colonel H. W. Laws, C.M.G., D.S.O., R.E.; William Lewisohn; Captain Thomas Hamilton Moore, J.P.; C. G. G. Pearson; Lieut. John Allan Rutherford, R.A.; Lieut.-Colonel H. St. Clair Smallwood, I.A.; Miss Grace Stebbing; Colonel Sir Hugh Davie White Thomson, K.B.E., C.B., C.M.G., D.S.O.

PAPER: Ocean Research in the Dutch East Indies. Prof. Dr. G. A. F. Molengraaff.

Sixteenth Evening Meeting, 21 June 1920.—The President in the Chair.

ELECTIONS.—Major S. M. Castle; William Thomson Craig; Charles Lewis Edwards, C.B.E.; Herbert Edwin Farden; James George Stanley Gausden; William Gibson; Charles Cross Goodrich; Sir Charles Louis des Graz, K.C.M.G.; the Rev. G. Stewart Hitchcock, D.D.; Captain George Hooper, R.N.R.; William Bloomfield Hume, B.SC., F.G.S.; Mervyn D. W. Jeffreys; M. A. de Lavis-Trafford, B.SC.; Major Beresford Clayton Lockhart-Jervis, D.S.O., R.E.; John Dudley Melhuish; Robert Cecil White; Major Malcolm Hugh Lucas, D.S.O., I.A.; Benjamin B. Moore; Sir Walter Townley, K.C.M.G.

PAPER: Through South-west Abyssinia to the Nile. Major L. F. I. Athill.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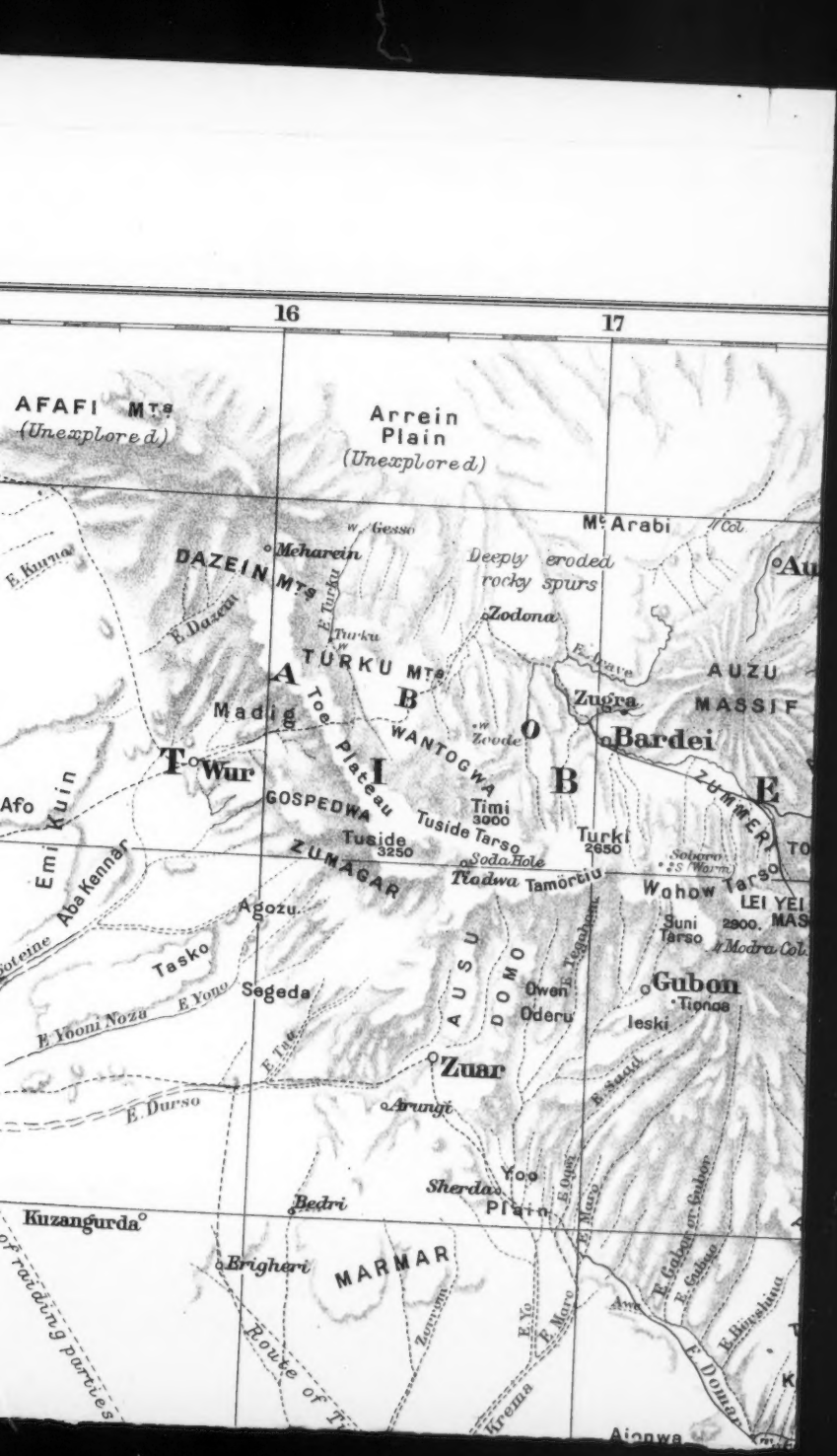
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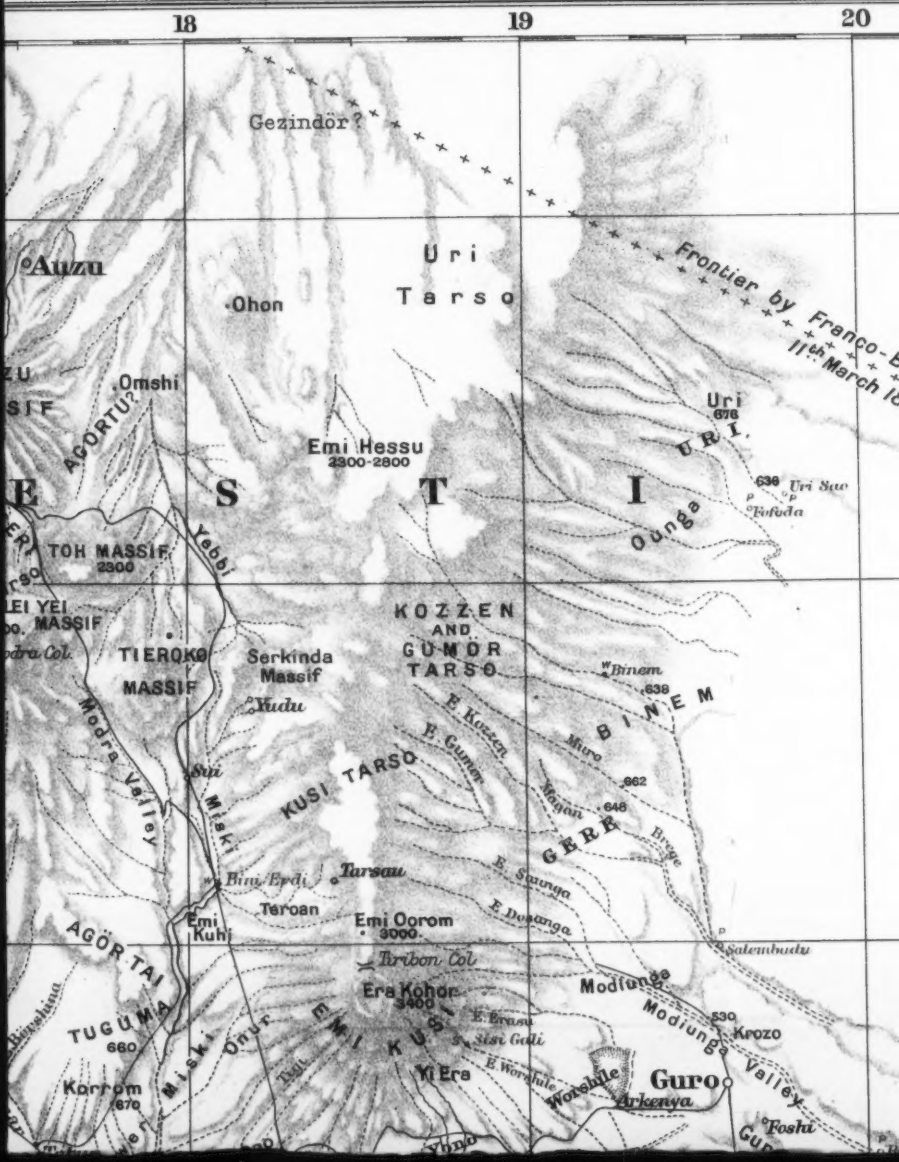
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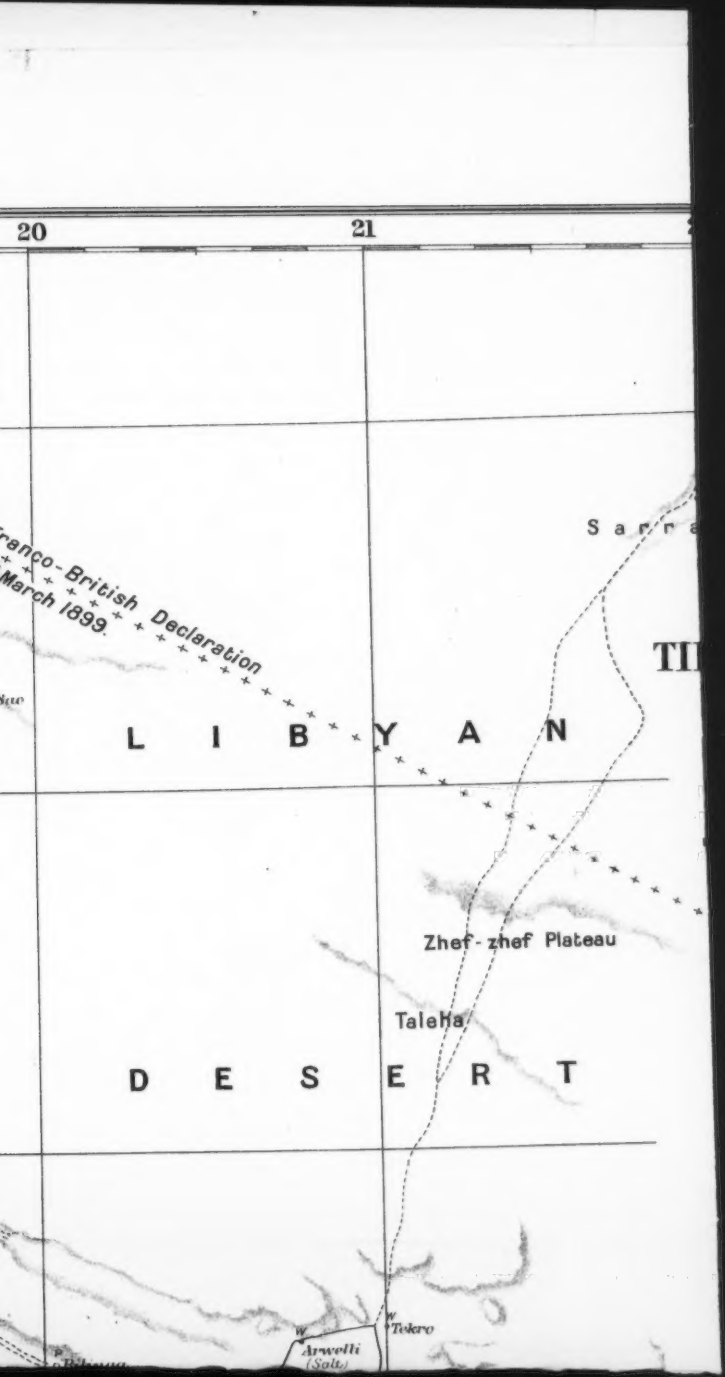
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FRENCH SUDAN.

Map to illustrate the
WORK OF THE MISSION TILHO
in
TIBESTI, BORKU, ERDI AND ENNEDI

Scale, 1/2,000,000 or 1/ 2M.

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1 Inch - 31·56 Stat. Miles & 1 Millimetre - 2 Kilometres

KILOMETRES 20 0 20 40 60 80 100 120 KILOMETRES

Reference.

Principal Routes of the Mission .....

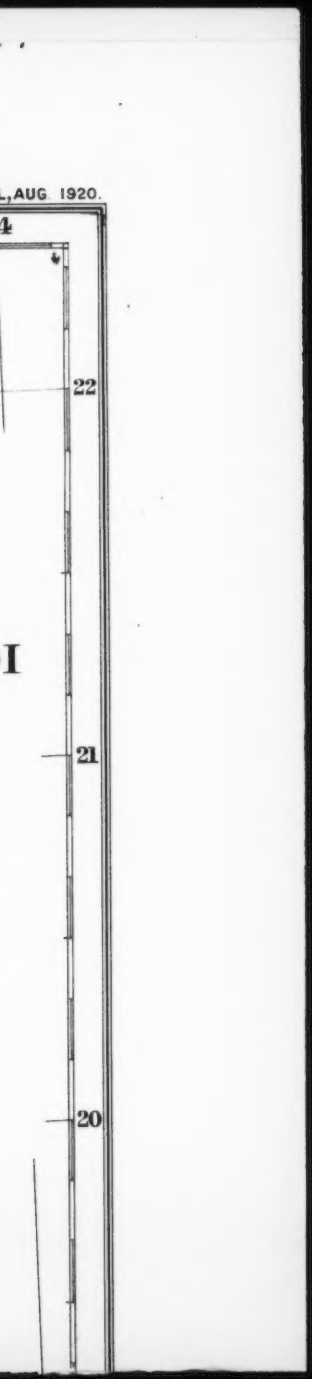
Other Routes .....

Permanent Wells, Springs & Pools ..... •W •S •P

Temporary " " " ..... ○W ○S ○P

Heights in Metres.

Redrawn from a map prepared for Lt. Col. Tilho by the Service Géographique de l'Armée. For astronomical positions and description of surveys see note to be published in the Geographical Journal, Oct. 1920.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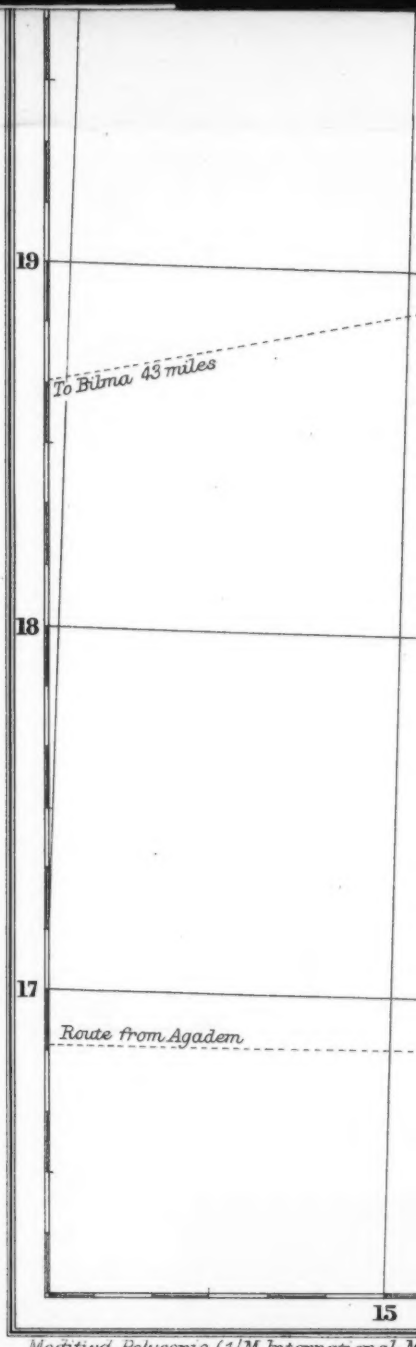
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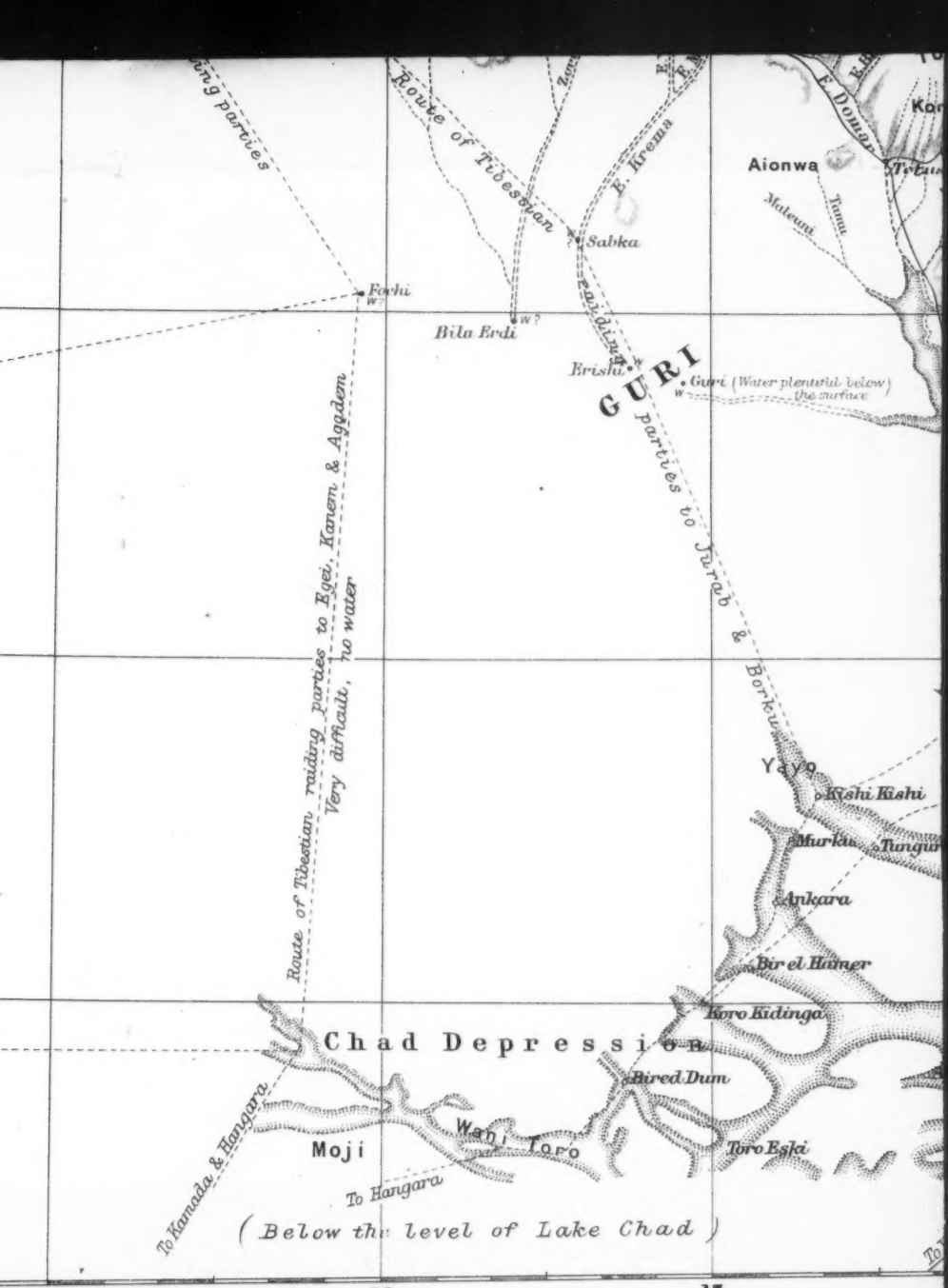

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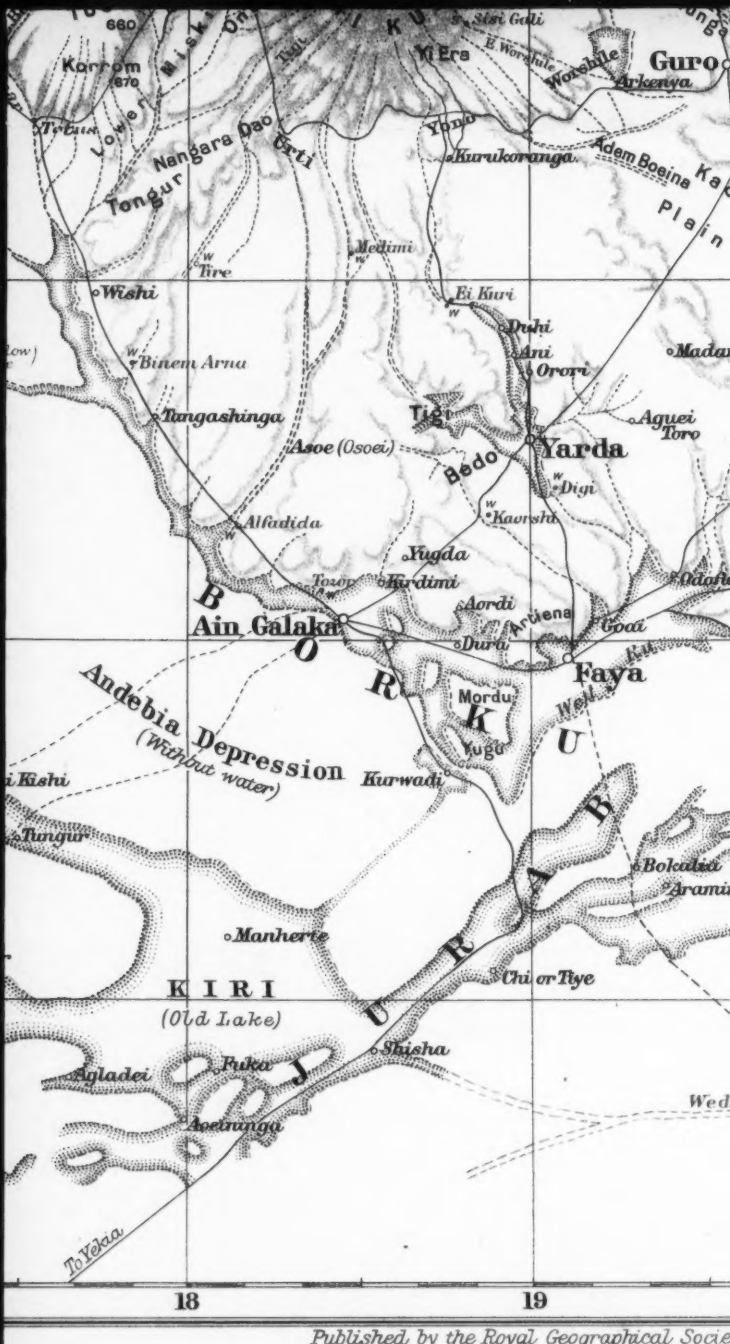
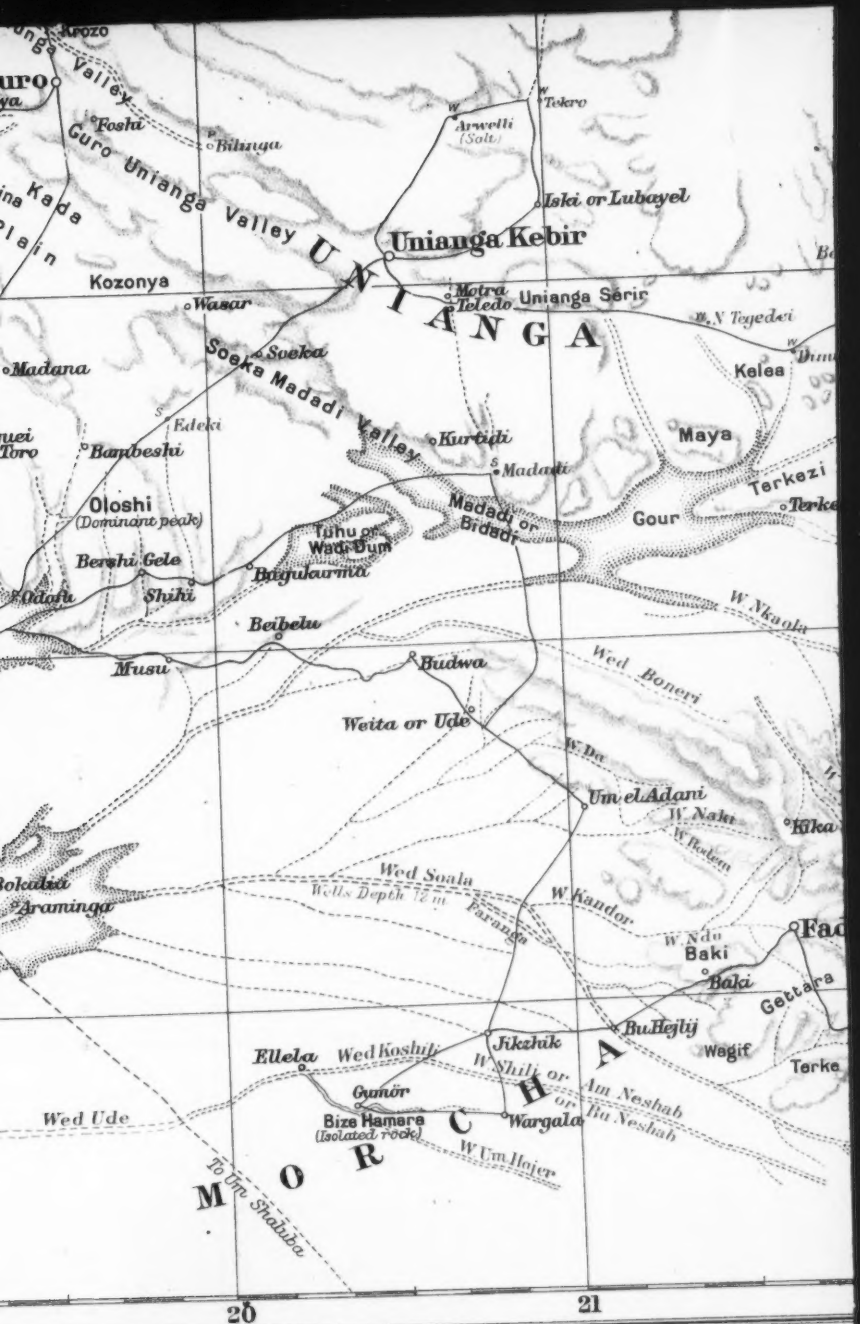


Published by the Royal Geographical Socie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Guro Unianga Valley
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Soeka Madadi Valley
Madana
Edeki
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(Dominant peak)
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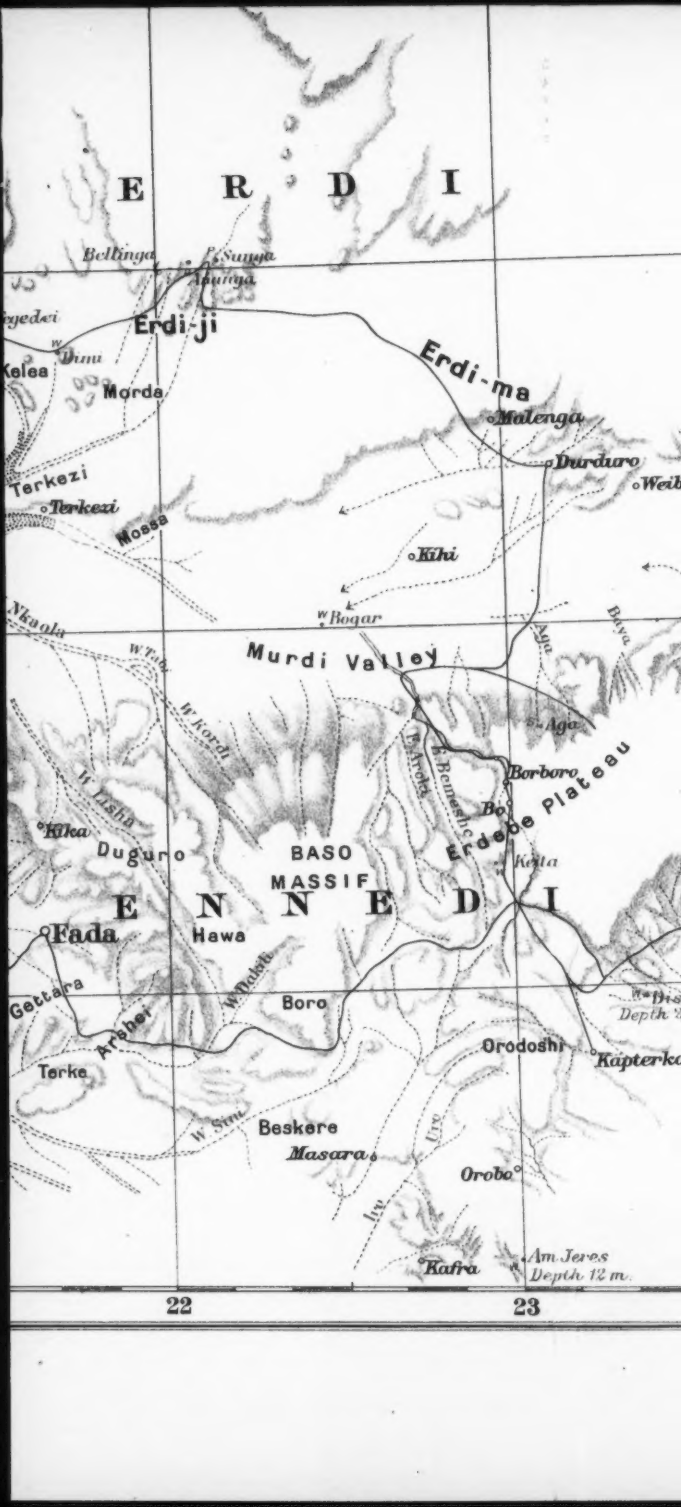
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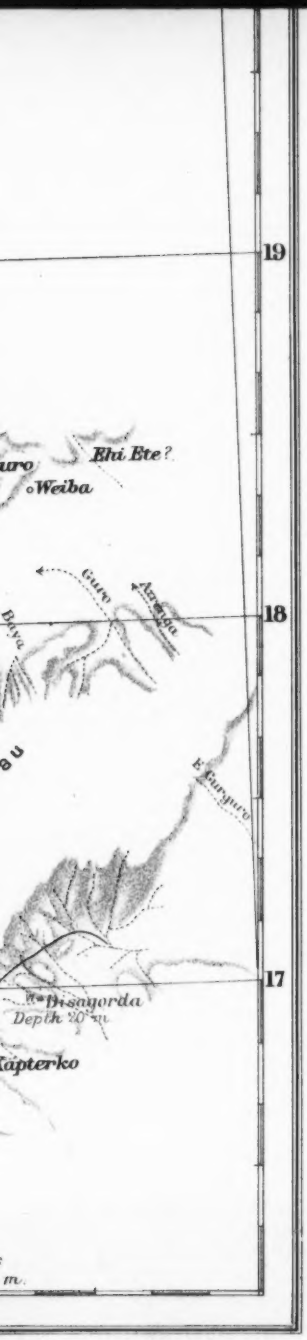

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